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# MASSAGE AND THERAPEUTIC EXERCISE

BY

MARY McMILLAN

Assistant at Sir Robert Jones' Clinic, Southern Hospital, Liverpool, England, 1911–1915; In Charge of Massage and Therapeutic Exercise at Greenbank Cripples' Home, Liverpool, England 1911–1915; Director of Massage and Medical Gymnastics, and Instructor of Nurses in Massage and Medical Gymnastics, The Children's Hospital, Portland, Me., 1916–1918; Instructor of Special War Emergency Course, and Director of Reed College Clinic for Training Reconstruction Aides in Physiotherapy, Portland, Ore., 1918–1919; Chief Aide, Walter Reed Army Hospital, Washington, D. C., 1918; Supervisor of Aides in Physiotherapy, Medical Corps, U. S. A. Washington, D. C., 1919–1920

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# FOREWORD

THE war has given opportunity to add knowledge and experience to many of the medical problems which were having consideration before this period, and this is particularly so in the Physiotherapies. The value of this feature of treatment, as well as its more accurate and intelligent application, had a marked impetus by the excellent work with its results done in England, France, and Canada, and the very large number of cases requiring these measures for prolonged periods emphasized the results which may be expected by it. Its use after acute infections and in the after-treatment of fractures and nerve injuries has been placed on an entirely new plane, and the different forms of the Physiotherapies have had the test of their comparative value by this experience. All of this has given opportunity for compiling the knowledge gained during this period and for formulating the various methods of its use, as well as for estimating the comparative value of the various forms.

Miss McMillan came to this department of medical war service well equipped by training and former experience, and in her position had extensive opportunity



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of observing the various forms of Physiotherapy and of studying their practical results, as well as the opportunity, during the same period, of teaching the aides who were enrolled for this purpose. We are fortunate to have at this early date the advantage of this recent experience brought into such shape that its employment may have wider application in civil practice, and that it may be used toward the relief of industrial cases which are to need the same kind of service. It has been the desire of all who were occupied with the physical reconstruction of the injured during the war to so preserve the resources developed during this period that they may be turned to the relief of the industrial reconstruction, which problem we shall always have with us. Miss McMillan's contribution is, therefore, particularly timely, and is to be recommended to those who are interested in the parts of Physiotherapy which comprise manual massage and therapeutic exercise.

E. G. BRACKETT,
Formerly Colonel Med. Corps., U. S. A.

# PREFACE

THE United States Army Medical Corps, through the Physiotherapy Division of the Reconstruction Department, made it possible from March, 1918 to March, 1920 for about 86,000 disabled soldiers to have the benefit of over three and one-half million treatments in the General Army Hospitals and camps throughout the United States. In addition, hundreds of men in France were able to receive treatments.

Because of the results achieved in the war emergency work physical therapeutic measures have already found favor, and the public is demanding that they be added to the science and art of healing wherever such treatment is indicated.

Physical therapeutics is by no means a new form of therapy, although hitherto the application has been limited chiefly to the orthopedic field.

About 1880 Dr. Weir Mitchell and Dr. Douglas Graham by their practice, teachings, and books were such strong advocates of massage that they aroused an interest among the medical profession in the United States. Claes J. Enebuske, Ph.D., Baron De Posse, Dr. Colleen, and Dr. D. A. Sargent organized and established a standard for normal training-schools of Physical Education. The first conference on this subject in the country was held November 29 and 30, 1889 in Boston, Mass.

In 1917 Dr. E. G. Brackett and Dr. Joel Goldthwait were interested in the reconstruction work that was being done among the Allied nations. They were the inaugurators of the Reconstruction Department of the United States Army in the early part of 1918. The department consisted of the Physiotherapy, Occupational Therapy, and Curative Workshop Divisions.

Soon after the formation of the department a demand arose for trained workers both for the Army Hospitals in the United States and for overseas service. A special appeal was made to the recognized schools of physical education throughout the country, and short, intensive courses of instruction were arranged in order to train women to meet the demand. These special training courses fitted about 800 women for the Physiotherapy Division. In June, 1918 the first overseas unit of Reconstruction Aides was ordered to France, and reported for duty at the United States Army Base Hospital No. 114.

At the same time there was a small group of faithful women ministering to the needs of returned soldiers at the Walter Reed General Army Hospital in Washington, D. C., with whom I was privileged to be associated. As the need for more trained women became urgent my work at Washington was interrupted for several months in order that I might assist in the training courses that were being given for women at Reed College, in Portland, Oregon.

At the Congress of American Physicians and Surgeons in June, 1919, at Atlantic City, Dr. Harvey Cushing

stated, "This has come to the minds of all, and mayhap a new profession for women as important as the nursing profession may arise through their invaluable services as Reconstruction Aides." Undoubtedly the courses of instruction, along with a period of practical work, have provided for many women an introduction into a new field of service.

Physical therapeutic methods are based solely upon the known facts of anatomy and physiology and are sound and rational. The practice of these methods requires an acquaintance with the pathologic conditions and symptomatology, together with a knowledge of the laws of electrophysics.

There are four distinct branches in Physical Therapeutics, namely, Massage, Therapeutic Exercise, Electrotherapy, and Hydrotherapy. The application of dry heat and radiant light in its various forms is prescribed in certain types of cases. There is a large field for future study in this subject. The linking of the various branches that comprise the subject as a whole, and the testing of the combination of one branch with another in order to obtain the most beneficial results are still matters for serious consideration.

This book has been written not only for students but also for the women who have passed through short, intensive courses of theory and practice, many of whom will not be satisfied until they have reached a higher standard of efficiency.

I want to thank my many staunch friends and co workers in the Reconstruction Department at the Walter Reed Army Hospital in Washington for their never-failing interest and patient aid in gathering and compiling the material for this book. My hearty thanks are extended to my friend Miss Emma Heilman. To Dr. E. G. Brackett, for his kindness and for the loan of many pictures; to Major Burt Carr, for his personal interest in the cardiovascular exercises, also for his contribution on two typical cardiovascular cases treated by graded exercises; to Dr. Frederic J. Cotton, for his keen interest and constructive criticism, and for the reprint of his pictures of a Volkmann's contracture; to Lieut.-Col. Coburn, Dr. Harvey Cushing, Dr. Frank B. Granger, Sir Robert Jones, Dr. Harry H. Kerr, Captain Mearns, and Dr. Harry Beal Torrey, for their help, kind suggestions, and letters of interest my most sincere thanks are due. Especially I want to express to Mr. Arthur Charles Watkins my warm appreciation of all his labor in connection with the editing of the book.

In conclusion, I should like to say that the spirit of loyalty, helpfulness, and co-operation that characterized the Reconstruction Department from the start was a large factor in achieving splendid results in the restoration of function and re-education of many disabled soldiers, thus enabling them to resume the activities of life.

MARY MCMILLAN.

BOSTON, MASS.,
*February*, 1921.

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# Massage and Therapeutic Exercise

## PART I

## MASSAGE

### CHAPTER I

**EFFLEURAGE; PETRISSAGE; FRICTION; TAPOTEMENT; VIBRATION; PHYSIOLOGIC AND THERAPEUTIC EFFECTS OF SAME**

THE word "massage" is derived from the Greek, and means to knead or press. It has come into modern use through the French, as is shown by several of the associated terms. It implies a scientific manipulation of the body tissues. It is a means for creating energy when it has become exhausted from any cause, and is a natural method of restoring the part injured or even the body as a whole to its normal condition.

The body tissues directly influenced by massage are the skin, the fascia, the muscular system, and the nervous system. The glandular, digestive, and bony systems are indirectly influenced. By reflex action through the sensory nerves in the skin a sedative effect is produced by manipulation. The muscles and soft tissues

are bound together by the deep and superficial fasciæ between the layers of which are many large blood vessels. The contraction and relaxation of the blood vessels have their beneficial effect in improving the nourishment in the cells of the entire body. The muscles are strengthened and made to grow by manipulation because increased nutrition is brought to the part through the blood-stream. By the physiologic shortening of muscle-fibers the venous and lymphatic system are affected. Each time muscle contraction takes place blood is forced through the veins, and the absorption of lymph is increased through the lymphatic vessels, accelerating the flow of the arterial blood, with its fresh supply of nutriment and oxygen. The motor and sensory nerves of the cerebrospinal system and of the autonomic or sympathetic system are stimulated or soothed according to the character of the manipulation used.

In order to show what physiologic objects may be attained by massage it is necessary to discuss the various forms of manipulations used, and then to show how the different forms of manipulation, coupled with movements to joints, gain certain definite physiologic objects.

Massage and therapeutic exercise have definite physiologic objects in view in every phase of their practice. Massage, as the term is generally used, includes both manipulation of soft tissues and movements to joints.

Massage will be considered as manipulation of soft tissues, or as movements done *upon* the body; and therapeutic exercise will be considered as movements to joints, or movements done *with* part of the body. These two measures, used one along with the other, or independently, form the basis of physical therapeutics.

There are five fundamental procedures in massage effleurage, petrissage, friction, tapotement, and vibration. From these five a large variety of manipulations may be derived.

## EFFLEURAGE

Effleurage, or movements of a stroking nature, in which the whole of the palmar surface of the hand is used, may be performed in two ways: first, by light stroking; second, by deeper stroking. Light stroking is used in the early stages of treatment or when deeper stroking cannot be tolerated by the patient. Although light, the stroke is firm and even, as undetermined stroking shows a lack not only in the understanding of technic but also of the patient's feelings.

Light stroking, even in its lightest form, has definite therapeutic effects. This type of effleurage, however, is perhaps one of the very hardest to perform, because it requires a great deal of aptitude as well as finished technic on the part of the operator. Stroking of this nature will be discussed in the chapter on Recent Fractures, where the Lucas-Championnière method is discussed.

Deeper stroking, or the usual manner of administering effleurage, is performed with a firm, even pressure. A definite amount of body surface should be decided upon by the operator before the hand attempts to start the stroke. For example, thorough stroking of the whole arm involves the following operations: First, from the finger-tips to just beyond the wrist-joint; second, from below the wrist-joint to just beyond the elbow-joint; third, from below the elbow-joint to just beyond the shoulder-joint.

It will be noticed in each subdivision that the stroke is carried from just below the distal joint to just beyond the proximal, the object being to carry the lymph to the proximal glands in order that it may be taken on through the lymphatics, back to the right side of the heart. The whole of the palmar surface of the operator's hand is used, and too much emphasis cannot be laid upon firm, even, rhythmic stroking. The thumb-to-thumb rule, which Douglas Graham so strongly advocates in his book on Massage, is admirable.

An operator who cannot use one hand as well as the other is not only limited in performing the normal operations of the work, but is a 50 per cent. worker. Therefore, from the start, one should practice more with the lesser developed hand as soon as some ability to perform certain manipulations is acquired. Great care should be taken to put pressure on the upward stroke, allowing the hand to return to its orig-

inal position without pressure, but without losing contact with the part being massaged. The fingers of the operator in performing effleurage should be held close together, but not stiffly. Relaxation on the part of the patient is necessary. The greater the facility of the operator to mold the hand into the part being massaged, the better the work will be. This molding is making use to the utmost advantage of the span between the thumb and the fingers *en masse*. Most of this molding process is directed by the thumb and the thenar eminence. No jarring or jerking either at the start or finish of the stroke should ever be felt by the patient.

Dr. W. Murrell says that dry rubbing is to be preferred because there is better muscular contraction in consequence of a greater flow of lymph; that electric currents are thus more easily developed in the tissues; and that greater elevation of the temperature of the part ensues; and that the patient is usually grateful if oil has not been used. Dr. Stretch Dowse suggests in cases of painfully stiff joints that equal parts of castor oil and chloroform will help to deaden the pain; he also recommends oil for abdominal massage. Margaret Palmer makes the statement that, until they learn how to use their hands, beginners will find it easier to work with a lubricant; and that later a lubricant should be used only under exceptional circumstances.

On the contrary, my experience teaches me that a student who is beginning to use the hands in various

forms of manipulation has little difficulty in getting accustomed to dry rubbing, and much prefers it, except in cases of excessive scar tissue, or for very emaciated patients, and after the long use of splints. Cod-liver oil or olive oil is sometimes used for young children following a general or local massage if it is desired that some

Fig. 1.—Effleurage of hand, thumb-to-thumb rule observed.

nutrition should be absorbed through the pores of the skin. In cases of this kind the massage has the physiologic effects desired, and the inunction has its nutritive value. Cocoa-butter and lanolin are among the best lubricants, but should be used sparingly. The latter is preferred by some because it is an animal fat.

In the first division of effleurage of the arm the pa

mar surface of the operator's hand supports the palmar surface of the patient's hand. The operator's working or active hand is then placed finger-tips to finger-tips with those of the patient; if the thumb-to-thumb method is adopted, it is much easier to fit hand to hand. Three or four firm, even strokings on the dorsal surface of the patient's hand are given. In order to

Fig. 2.—Position of hands for effleurage and petrissage of forearm.

conserve time and energy the operator, without changing hands, turns the patient's hand from the prone to the supine position; the supporting hand of the operator then becomes the active hand. The palmar surface is then stroked three or four times in a similar manner. In effleurage of the forearm the patient's hand is in the middle position between pronation and supination.

One hand of the operator is used for the flexor group, while the other hand is supporting the part; then the hands should be reversed for the extensor group. In the second division of the arm the stroke is taken to just beyond the elbow-joint, one hand covering the flexor group, the other hand covering the extensor group. The hands are now in position for effleurage of the arm, which is the third division. In a similar manner the flexor and extensor groups, each in turn, are stroked. Each stroke should be carried to the proximal glands of its division.

Subdivisions of the lower extremity correspond to those of the upper: First, foot; second, leg; third, thigh. In effleurage of the lower extremity the same procedure is used as with the upper extremity. The leg which is being massaged should never hang from the knee-joint, but should be well supported from the hip-joint.

The plantar surface of the foot from the tips of the toes to the heel is stroked with one hand. The other hand takes the stroke on the dorsal surface from the toes to beyond the ankle-joint. The whole palmar surface of the hand should conform to the sole of the foot.

The leg should be grasped with one hand covering the muscles on one side of the crest of the tibia, the other hand grasping the muscles on the other side. In this way one hand covers the anterior tibial group and the peroneal, while the other hand grasps the gastroc-

nemius group, the underlying posterior tibial group being affected by the pressure from the superficial group. Always, where there are several layers of muscles, especially where the muscles are much developed, the stroking should be deeper, in order to reach the veins and lymphatic vessels which lie nearer the bone.

Fig. 3.—Effleurage of leg.

The third division of the lower extremity is the thigh. Here, because there is a larger surface to cover, it is well to stroke with alternate hands. At first both hands grasp the limb, finger-tips touching in the popliteal space, between inner and outer hamstring muscles. There should be about six alternate hand strokings over the posterior surface of the thigh, bringing the hands over the lateral aspects of the thigh to the anterior sur-

face, where similar action is brought into play, unti the whole of the thigh has been thoroughly stroked This completes the general outline for effleurage of th limbs.

It is well to divide the back into four main divisions as there is so great an extent of surface. The patien should be in prone lying position on a straight plinth o bed with no pillows under the head. This position can not be assumed by patients suffering from heart com plications or from phthisis, in which a hacking cough i aggravated by this position. In either of these cases, o when it is found inadvisable for the patient to lie flat the back may be massaged while the patient is in a sitting posture. In general, however, the prone lyin position is not at all uncomfortable for the majority o patients.

The first division of the back is from behind the ears, along the slope of the neck muscles, to the tip of the shoulder-girdle. At the beginning of the stroke the forefinger is separated from the other fingers in order to get well behind the ears, and the stroke is carried until all the fingers come in close contact with each other again at the nape of the neck. With the same firm, even pressure, the stroke is then carried to its termination at the acromion process. In this division both hands of the operator start below the inferior angle of the scapulæ and work in opposite directions from the center line, the stroke being repeated several times.

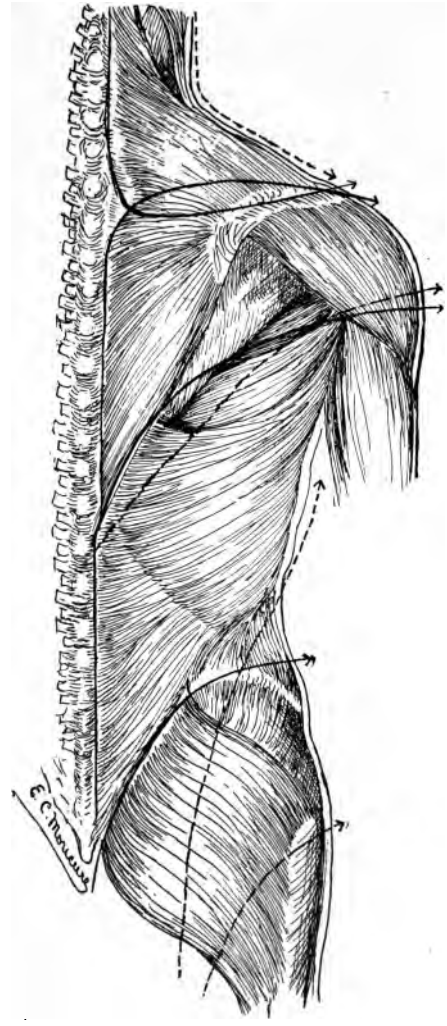

Fig. 4.—Division of the back. Dotted lines outline the fingers and black lines outline the area over which the thumb glides.

In the third division the hands start over the region of the sacrum and both hands stroke upward on corresponding sides until they reach the axilla. They are then brought back, one on each side of the trunk, each describing a circular movement. Care should be taken to cover the whole area with the upward stroke.

Fig. 5.—Effleurage of upper part of back.

The glutei is the last division of the back. Here heavier pressure should be exerted on account of the density of fascia in this region. The operator, starting with one hand on each side of the buttocks, strokes from the apex of the sacrum over the whole of the gluteal muscles, coming back without pressure to the starting-point. When each division of the back has

been effleuraged, it is well to cover the whole surface with long, firm, even strokes from the sacrum to the nape of the neck. As the upper divisions of the back are completed, care should be taken to keep under cover the portion of body that has been massaged.

For effleurage of the chest and abdomen the patient resumes the supine lying position. The head may rest

Fig. 6.—Effleurage of chest, first part of stroke.

on a pillow low enough to place no strain on the muscles and blood-vessels of the neck. The hands are placed in much the same position on the anterior surface of the neck as they were on the posterior surface. One hand works on either side from the front of the ear over the front of the neck, the stroke being carried to the tip of

the shoulder-girdle. This is repeated three or four times.

In effleurage of the chest each hand starts the movement with the tips of the fingers on the acromion process. The hands are carried toward the center line of

Fig. 7.—Completion of effleurage stroke for chest muscles, hands now in position for petrissage of same.

the chest and around the breasts, the stroke terminating in the axilla. This is repeated several times.

Effleurage has a reflex action upon the nervous system by affecting the peripheral sensory nerves. It also hastens the blood to the heart by its action upon the cutaneous blood-vessels and lymphatics. Effleurage is

always used before the other forms of manipulation and as a final procedure.

## PETRISSAGE

Petrissage, or kneading, may be performed either with the whole of the palmar surface of the hand or by

Fig. 8.—Petrissage of muscles of the arm.

fingers and thumb. For picking up small muscles (as, for example, those of the face) the forefinger and thumb are used. The same divisions of the forearm and arm are used as for effleurage. First the flexors and then the extensors of the forearm are petrissaged. A useful variation of petrissage may be accomplished by the flexors and extensors being grasped by alternate hands,

and a wringing movement being performed. The anterior surfaces of the deltoid region are then petrissaged.

The lower extremity also is divided into three divisions. The foot is petrissaged, special attention being paid to the muscles of the plantar surface. The hand of the operator, making special use of the thenar emi-

Fig. 9.—Petrissage of the shoulder muscles in which a wringing movement is used.

nence, kneads well into the plantar muscles. As the dorsum of the foot is so tendinous, petrissage is supplemented by running frictions between the interossei muscles. The spine of the tibia is used as a guide for the thumb of the operator in petrissage of the leg. On one side of the spine the muscles are kneaded by one hand, and on the other side of the spine by the other.

If the small anterior tibial muscles require special care, finger-and-thumb petrissage is useful, as the muscle group is small and lies snugly against the tibia. In giving petrissage to the quadriceps group the two hands are used as one, the thumb of the right hand lying alongside the forefinger of the left hand, or vice versa. In this way the two hands, as one, pick up the anterior

Fig. 10.—Petrissage of calf muscles.

thigh muscles. The adductors and hamstrings are petrissaged by alternate hands.

The back is divided in the same way for petrissage as for effleurage. Each section in turn is petrissaged by a pressure of muscles against the ribs, or, in the lumbar region, upon the abdominal wall. These muscles cannot be picked up as those in the limbs. The whole

of the palmar surface of the hand is brought into play, but not in a molding manner as for the limbs, because the contour of the surface is flat instead of rounded.

The glutei muscles and fascia, being dense, require a much deeper kneading than those in any other region.

Fig. 11.—Petrissage (two hands as one) over the quadriceps extensor group.

The kneading movement over the glutei is similar to that in kneading dough.

The chest muscles are petrissaged in much the same way as those of the back. In abdominal massage the operator usually assumes a position on the right side of the patient, the arms of the operator being on a level

with the patient's abdomen. Kneading of the abdor inal muscles is of two types—transverse and circula Both hands of the operator are placed side by side wi the index-fingers together. From the right side tl abdominal muscles are pressed toward the center wi the heels of the hands, the fingers pressing from the le side toward the middle line. This transverse kneadi is light at first, and the depth and pressure of the mov ment are gradually increased. The circular kneadi immediately follows the transverse without the loss contact and without interruption. In circular knea ing the hands are cupped, the ulnar border of the o starting the movement which is carried on by tl finger-tips toward the ulnar border of the other. Tl movement terminates with the heels of both the hanc and is continued for from three to five minutes.

Petrissage acts upon the deeper blood-vessels, lymp atics, and nerves. It also assists the glandular functio by promoting secretions and excretions. The loc temperature is raised and absorption is promoted.

## FRICTION

Friction, or circular friction, is that form of ma ipulation in which the tips of the fingers or the finge and thumbs are used—more especially around the bo prominences of joint surfaces. Pressure in a circul manner is brought to bear upon the underlying stru tures. This form of manipulation is extremely useful

breaking down adhesions and in promoting absorption. Friction should be followed by effleurage in order to send on through the blood-stream the broken-down products of inflammation.

Friction is performed by circular movements with the finger-tips, or with two or three finger-tips, or even with

Fig. 12.—Circular frictions on phalangeal joints upon alternate fingers.

one, according to the amount of surface to be covered. Around joint surfaces pressure is brought to bear upon the underlying structures. In friction of the phalangeal joints the joints of the first and third fingers are manipulated between the finger and thumb of the operator.

In the same way the second and fourth fingers receive friction. If friction is given simultaneously to alternate fingers, one hand of the operator is not in the way of the other. Friction is given around the wrist-joint with two or three fingers and thumb. In the lower extremity the toes and ankle-joint receive similar treatment. In cases in which there is excessive scar

Fig. 13.—Friction around the ankle-joint.

tissue friction is the most useful form of manipulation to loosen it. The effete matter in cases of bruises, if allowed to remain, will become organized and cause thickening of the surrounding tissues. Friction in such cases will dispose of the effusion and help to open up the blood-vessels.

Running frictions are sometimes used to advantage in

a case of recovering sciatica. Over the denser area the thenar eminence is used for the circular frictions, starting over the great sciatic notch where the sciatic nerve emerges from the pelvis. These friction movements are carried down the whole area of the terminal endings of the sciatic nerve.

Friction prevents or breaks down adhesions if tissues are bruised, matted, or thickened, and is especially used to advantage around joint surfaces.

### TAPOTEMENT

Tapotement is a series of brisk blows, one following another in rapid succession. It may be performed in four ways: Hacking, clapping, tapping, and beating.

Hacking is the most common form of tapotement. The operator's hands are held with ulnar borders of each ready to strike. The fingers are slightly flexed and parted, and the hands strike alternately. As the blow falls the fingers strike together. They are then separated, and the hand is raised some distance from the patient before the blow is repeated. Hacking is performed so as to strike transversely across the muscle-fibers from one end of the muscle to the other. This causes mechanical contraction of the muscle.

Clapping is done with a cupped hand, the fingers and thumb being slightly flexed and the palmar surface contracted. This form of tapotement is especially useful for covering the entire surface of the back. Clap-

ping is also used over the chest muscles. It has a stimulating effect when used over peripheral vessels and nerves.

Tapping is performed with the fingers cone-shaped, and sharp, brisk tapping movements are applied with the tips to the surface desired. Over the nerve trunks,

Fig. 14.—Hacking longitudinally over the area of intervertebral foramina from which thirty-one pairs of spinal nerves issue.

where they issue from the cord through the intervertebral foramen, this tapping movement may be performed with sufficient force to overcome the density of back muscles and spinous ligaments. This has a stimulating effect upon the nerve centers.

Beating is done with the ulnar border of the closed

hand, as in making a fist. This form of tapotement is used over the gluteal muscles where the fascia is dense.

If tapotement is strong enough in its application the relief of pain is quite marked. This is due to a state of

Fig. 15.—Clapping over the whole of the back.

fatigue in the nerves brought about by the mechanical stimulus which follows this form of manipulation.

Tapotement excites capillary circulation, has a stimulating or sedative effect upon the nerves, and causes muscular contraction without the will power being brought into play.

## VIBRATION

Vibration is performed with several fingers or even with one, and at times the whole palmar surface of the hand is used. A trembling sensation is conveyed by the operator over the most cutaneous part of a nerve; for example, the forefinger is placed over the supra-orbital notch and a vibratory movement is conveyed to the supra-orbital nerve. In cases of neuralgia this vibration will have a benumbing effect which will react in a sedative manner if the vibration is given with sufficient force. Vibration over the abdomen is effected with the whole palmar surface of the hand. This vibration is particularly helpful for its stimulating effect upon the stomach, intestines, and the other abdominal organs.

Vibration stimulates glandular and vascular activity and the organs of digestion. It has a stimulating effect upon the nervous system by its action upon the nerve centers and upon the terminal nerve branches.

# CHAPTER II

## MOVEMENTS TO JOINTS—PASSIVE, ACTIVE, RESISTIVE (TWO FORMS), ASSISTIVE

THERE are four distinctive types of therapeutic exercise, or movements done *with* the body—passive movements; active movements; resistive movements (two forms), and assistive movements. Of these four types, passive movements are so closely allied to manipulation of soft tissues that they might be called its complement. Massage is seldom ordered without movements to joints. The two branches are distinct and must not be confused.

There are three stages of muscular action involved in joint movement. Immediately before muscular action there is a latent period in the nerve impulse, following which are:

(1) Positive action on the part of the muscle, through which maximum contraction is reached, in which the origin and insertion of the muscle are approximated.

(2) Negative action, in which muscle relaxation and lengthening of muscle take place, and the distance between origin and insertion is increased.

(3) Static condition, in which the origin and insertion of the muscle are maintained in constant relationship to each other.

## PASSIVE MOVEMENTS

For the sake of convenience to the student learning massage, holdings for passive movements to the various joints throughout the body are described below. The holdings, in general, apply for resistive and assistive movements. When movements to joints are given, the parts above and below the joint should be supported. Slight traction exerted when passive movements are given will aid the function of the deep lymphatics around the joint. Each joint movement should be taken to its limit three or four times.

### Upper Extremity

*Hand.*—The phalangeal and metacarpophalangeal joints are hinge-joints, and their anatomic arrangement is such that they may be simultaneously exercised in the following manner: The palmar surface of the hand of the operator covers the dorsal surface of the patient's hand, the fingers of the operator covering those of the patient. The wrist-joint should be supported by the operator. If a condition indicates attention to individual phalanges, the procedure is much the same. The thumb is taken separately, flexed, and extended. The thumb, having a saddle-joint, is capable of a circumductory motion.

*Wrist.*—The forearm above the wrist is held by one hand of the operator, the other hand grasping the metacarpal region, giving movements of flexion and

Fig. 16.—Flexion of phalangeal joints.

Fig. 17.—Hyperextension of phalangeal joints.

extension. A lateral pull each way with slight traction is also given to the wrist-joint.

Fig. 18.—Flexion of elbow-joint.

Fig. 19.—Supination of forearm from the prone position.

*Elbow.*—In order to take the weight off the forearm the patient should be seated or lying with the arm, shoulder, and elbow resting on a table or plinth. The forearm

is grasped above the wrist, and flexion and extension movements are given. In order to give pronation and supination the hand of the patient should be held as in shaking hands, elbow being supported. The palmar surface is turned upward in the fully supine position; then the palmar surface is turned downward in the prone position.

*Shoulder.*—In accordance with the laws of leverage, muscular action is more easily performed if the patient assumes the lying position. Later, movements can be given in the sitting position for the same series of exercises, either of an active or passive nature. In flexion, the arm is carried in the forward horizontal plane and back to the body line in the same plane to the extended position. Adduction is then given, followed by abduction, in which the arm is carried to an angle of 90 degrees with the body. If the angle between the arm and the body is more than 90 degrees, the movement is no longer confined to the shoulder-joint, but involves some shoulder-girdle movement. This, taken to its limit, brings the arm into the vertical position, but is not strictly a shoulder-joint movement. For rotation the arm is raised by the operator to the abducted position. The forearm is flexed, one hand of the operator supporting the elbow-joint, the other one holding the forearm above the wrist-joint. In this manner the head of the humerus is rotated to its limit in the glenoid cavity of the scapula,

in an inward and outward rotatory movement. Circumductory movements are given with the arm of the patient in much the same position as for axial rotation. The arm is carried in a circular movement, first forward and then backward. Circumduction exercises all of the

Fig. 20.—Flexion of shoulder-joint.

various muscle groups which control the shoulder-joint action.

*Head.*—With the patient seated, the head is grasped on each side by the hands of the operator, and is flexed and extended. This action is produced by rocking the head on the concave surfaces of the atlas. Rotation is accomplished by rotating the head on the odontoid peg of the axis. The next movement is circumduction,

which involves the anterior, posterior, and later
muscles of the neck.

### Lower Extremity

*Foot.*—The phalangeal and metatarsophalangeal joint
are hinge-joints, corresponding to the distal joints i

Fig. 21.—Inversion of the ankle.

the upper extremity. For movement of the toes on
hand of the operator grasps the ankle-joint, the othe
hand moves the toes *en masse*, making a full range o
flexion and extension.

*Ankle.*—The ankle is held with one hand above th

joint, the other hand grasping the foot and giving flexion and extension to the ankle-joint. For inversion, the foot is held between one or both hands of the operator and turned inward; for eversion, with the same position, the foot is turned outward.

*Knee.*—When movements to the knee-joint are given the patient should be in a supine lying position. One

Fig. 22.—Patient in prone lying position for flexion of knee-joint if forcible stretching is necessary in cases of fibrosis.

hand of the operator grasps above the knee-joint, the other holding the heel. Full range of flexion and extension is given in this position. In cases of fibrosis of the knee-joint the operator has more control in giving forcible flexion if the patient is in the prone lying position (Fig. 22).

*Hip.*—With the patient in the supine lying position, one hand of the operator grasps the heel of the patient, the other hand being placed in the popliteal space (Fig. 23). As the limb is flexed the hand in the popliteal space is brought forward and placed over the head of the tibia. Full flexion of the thigh upon the trunk is assisted by the pressure of the hand that is over the

Fig. 23.—Hands in position for flexion of thigh on trunk (first part of movement).

head of the tibia. As the limb is returned to full extension the hand is slipped back to the popliteal space into its original position. To get abduction and adduction of the thigh the knee-joint is fully extended, and the whole limb is moved outward and inward. For rotation of the hip joint the knee is flexed, and the leg is grasped in the same manner as for flexion and exten

sion. Using the leg as a lever, the head of the femur is fully rotated, outward and inward, in the acetabulum. Circumduction is a combination of all hip-joint movements, each muscle group that controls the hip-joint being brought into play in this movement.

Fig. 24.—Flexion of thigh on trunk, hand in popliteal space, slipped over head of tibia to complete the movement.

A passive movement, therefore, is one which is performed by the operator while the patient relaxes as much as possible. Passive movements act more particularly upon the blood-vessels and lymphatics in the tissues surrounding the joint, and upon the nerves supplying the joint.

### ACTIVE MOVEMENTS

An active movement is one that is performed entirely by the voluntary impulse of the patient. Voluntary impulse originates in the cortical motor area of the brain. Active exercises are especially beneficial if there is some lesion in this area. Active movements will be discussed in the section on Therapeutic Exercise. They not only have their place in remedial work, but in exercise of affected joints which is so intimately correlated with massage. Active exercises are by far the most beneficial form in cases in which re-education is required.

### RESISTIVE MOVEMENTS

In any active movement a certain amount of resistance is furnished by the weight of the body or by the opposing muscles. In the first form of resistive movements some *outside* resistance is offered either by the operator or by apparatus. In the second form of resistive movements, which is not commonly used, resistance is exerted by the patient, who attempts to hold the contracted muscle against the operator's effort to lengthen it. In the first form there is a positive action on the part of the muscle to contract against the resistance that is offered by the operator. Resistance against positive muscle action will be termed **positive resistance.** This movement has been known as passive-resistive movement, or concentric duplicate movement. In the second form there is a negative action on the

part of the muscle that is lengthened by means of the operator's effort, resistance being offered by the patient. Resistance against negative muscle action will be termed **negative resistance.**

Dr. Harry Beal Torrey, of Portland, Oregon, suggests that the terms "shortening resistive movement" and "lengthening resistive movement" might be used as more directly descriptive of the physiologic action which takes place in the muscle. He further explains that a positive resistive movement in which one muscle acts against another may be described as "a shortening movement with external (or internal) resistance"; and that a negative resistive movement may be described as "a lengthening movement with external (or internal) resistance."

*Positive Resistance Movements.*—This is by far the most useful form of resistive exercise in therapeutic work. Its action strengthens the muscles as no other form of exercise is capable of doing. Resistance is gradually increased to the middle third of muscle contraction, and in the remaining third it is decreased. Resistive movements provide the best way to make one muscle group act alone and exclude the antagonizers. If there is an injury to the posterior aspect of the elbow, the two forms of resistance movement will give exercise to the elbow-joint, at the same time almost excluding the triceps from the action. The forearm is flexed by the patient, resistance being offered by

the operator, this being called a positive resistance movement. Extension is accomplished by the operator while resistance is applied by the patient, this being called a negative resistance movement. In this way reflex muscular spasm is obviated and more movement in the joint is attained. Every muscle action involves the antagonizing force of muscle groups. Resistive movements are easier upon the intra-articulating surfaces of the joint. "Every movement of the limbs takes place through the co-operation of two groups of muscles opposed to each other." The tension of the flexors on one side of the joint equals that of the extensors on the other side, and thus a balance of muscle action is maintained. By the application of resistance to one of the groups only one-half of the tension is exerted upon the joint surface. If intelligent resistance is employed it is easier upon the articulating surfaces of a painful or inflamed joint than either active or passive movements.

*Negative Resistance Movements.*—This form of exercise is never used during any stage of recovering paralysis; any form of movement which would lengthen the already overstretched muscles is contraindicated. An explanation has, however, been given in the precedin paragraph of how this form of negative resistance mo ment may with great advantage be used in conjunct with positive resistance movement. The principal indeed, of this form of movement is in the isolation certain muscle or of a muscle group.

Resistance movements cause an afflux of blood to the active muscles controlling joint movement, assist nutrition in the surrounding tissues, and promote glandular secretions and elimination.

## ASSISTIVE MOVEMENTS

An assistive movement is one in which the patient is encouraged to perform as much voluntary motion as the muscle is capable of exerting. The operator assists the movement if voluntary nerve impulse is incapable of completing the movement. In cases in which voluntary impulse is lacking, assistive movements are beneficial. This form of movement is a prelude to active and resistive exercises, especially in the treatment by exercise of recovering cases of infantile paralysis. Both resistive and assistive exercises require intelligent management on the part of the operator, guided by an understanding of the joint mechanism and of the neuromuscular action which controls the joint movement. Grading of resistance or of assistance, dosage, fixation, and a knowledge of the laws of gravity affect very materially the results obtained.

## CHAPTER III

### SOME PHYSIOLOGIC OBJECTS GAINED BY MASSAGE

MASSAGE is used for its physiologic effects upon the body structures. Each individual case calls for a special procedure of manipulation or for a combination of procedures. The physiologic effect desired is the basis for all prescription. For instance, in a case in which adhesions were already formed, effleurage would not be the principal mode of procedure. Deep frictions, however, followed by effleurage in order to supplement the effects produced by friction, would be an ideal prescription. Too much emphasis cannot be laid upon the entirely different form of treatment necessary for acute, subacute, and chronic conditions. The following are some physiologic objects gained by massage:

1. The skin and its structures are nourished.

2. The venous and lymphatic flows are increased, and thereby waste products are more easily eliminated from the body.

3. The blood-stream is regulated, and, therefore, more even temperature of the body is gained.

4. Muscle-fiber is strengthened and made to grow as a result of increased nutrition.

5. The nerves are either stimulated or soothed.

6. The blood is attracted from the deeper tissues to the surface, and, therefore, internal congestion is relieved.

7. Adhesions are sometimes prevented or removed.

8. The reabsorption of swelling is hastened, and thickened tissues are frequently reduced.

*The Skin and its Structures are Nourished.*—The different physiologic effects of massage upon the skin, with its sudoriferous glands, sebaceous glands, and peripheral nerve endings, vary according to the form of manipulation used. For example, the lightest form of effleurage has decidedly a sedative effect upon the sensory nerves, and reflexly affects the motor nerves. The relief of local pain alleviates the strain upon the whole of the nervous system. This is very readily seen in the Championnière method of the treatment of recent fractures. Severe muscle spasm, as the result of the lightest form of stroking, so light as to have no mechanical effect, is often surprisingly alleviated. The action is purely reflex. The muscular spasm which follows dislocation of the shoulder-joint is perhaps the most trying condition for the surgeon to overcome. So frequently may this condition be relieved after quiet rhythmic stroking over the affected area that forcible manipulation without an anesthetic may be undertaken. The vasomotor centers are stimulated through the autonomic system by effleurage, petrissage, and tapotement;

the effect being the dilatation and relaxation of the walls of the blood-vessels.

*The Venous and Lymphatic Flows are Increased, and Thereby Waste Products are More Easily Eliminated from the Body.*—Petrissage is the most effective form of manipulation to gain these results. When the patient is thoroughly relaxed the muscles, blood-vessels, and lymphatic spaces throughout the tissues are manipulated in such a way as to hasten the venous blood and the lymph toward the heart. The vessels under treatment are dilated, and thus resistance is lowered. Because of this lessened resistance in the tissues the backward pressure of the arterial blood upon the heart is relieved. The heart, in consequence, is able to contract more readily and so empty its cavities more completely. The exertion of pressure upon the lymphatic vessels and glands aids the absorptive system. Waste products are, therefore, more easily carried to their organs of elimination.

*The Blood-stream is Regulated and, Therefore, a More Even Temperature of the Body is Gained.*—Experiments and clinical observation have proved that both red and white corpuscles, as well as the amount of hemoglobin, are increased by massage. Massage also causes a change in the distribution of the corpuscles. Many corpuscles which were adherent to the walls of the vessels and which, without external pressure, would have remained so, are forced on through the circulation. The heat-

producing property, oxyhemoglobin, in the blood-stream is distributed more evenly throughout the body, and thus the temperature of the body is regulated. Muscle-fiber is strengthened and made to grow as a result of increased nutrition. The circulation of the blood is increased in a muscle that is undergoing manipulation. The fresh supply of oxygen and food products that are carried to the tissues by the blood-stream helps to build up and renew the muscle-fibers so that they are increased in size and in strength.

*The Nerves are Either Stimulated or Soothed.*—In cases of neurasthenia, in which there is a sluggish nerve reaction, there is no doubt that stimulation through motor, sensory, and autonomic systems will show excellent results when all else fails. As the mind plays so important a rôle in all such cases the operator must always have in mind the stimulation of the nervous system through each existing channel. Massage given for its sedative effect, in cases in which muscular spasm was pronounced, has already been discussed.

In 460 B. C. Hippocrates, a noted Greek physician, made the following statement in relation to rubbing: "Things that have the same name have not always the same effect. Rubbing can bind a joint that is too loose and loosen a joint that is too rigid. Rubbing can make flesh or cause flesh to waste." Hippocrates might also have added that rubbing can have a stimulating or a sedative effect upon the nerves. In order to gain these

desired effects the operator must exercise both reason and intelligent understanding, two very important factors, if good results are ever to be accomplished in this kind of work.

The treatment for the neurasthenic of the phlegmatic type is a stimulating massage, followed by resistive exercise, progressing, as soon as the patient is able, to outdoor walks of prescribed length. The patient should be encouraged to participate in outdoor sports, such as golf and tennis.

In direct contrast to the phlegmatic type is the overwrought, highly strung nervous type, which is so commonly seen in the cities of the United States of America. Here life not only demands the most in human efficiency, but constantly keeps the nervous tension high, whether it be in professional, commercial, or social life. Even in athletics this tension is marked. It is no small wonder, then, that women, and men too, have not the rugged nervous temperaments of their forefathers. The treatment for this type must be wholly adapted to produce a sedative effect. This consists of quiet stroking, deep kneading, passive exercises, and relaxation, in which the patient is taught to "let down" for a definite period each day until the tension of the nervous system is at least relieved. The secret of obtaining results in the treatment of this type lies in the personality of the operator who should understand the meaning of "mental gymnastics" and the control of the inhibitory centers.

*The Blood is Attracted from the Deeper Tissues to the Surface and, Therefore, Internal Congestion is Relieved.*—By inducing hyperemia much the same results may be attained through massage as are produced by an application of heat or by any form of counterirritant.

*Adhesions Are Sometimes Prevented or Removed.*—Prevention is better than cure. For example, in a case in which tendons, fascia, blood-vessels, and ligaments have been bruised and injured, the ideal treatment would be effleurage, which will dispose of the effused products through venous and lymphatic channels, keeping the circulation in the affected area in better condition; and passive and active movements to distal joints, which will prevent the tendons from adhering. When adhesions have already formed, the treatment should consist of a circular, frictional movement around the part injured, followed by effleurage. The broken-down products of inflammation are thus more readily transferred into the blood-stream.

*The Reabsorption of Swelling is Hastened, and Thickened Tissues are Frequently Reduced.*—In a case of synovitis, when the acute inflammation has subsided, it is well to aid the absorption of the excessive exudate into the lymphatic vessels in the proximal area. A free channel should be opened to dispose of the products of inflammation before they have become too firmly organized. Infiltrated tissues, if assisted in this external, mechanical way, will respond very well to early treatment.

In edematous cases, in which tissues have become thickened and induration is present, the balance of play in the interchange of lymph from the capillary walls and the lymph spaces is lost, resulting in an accumulation of lymph in the cellular tissues, which if not early disposed of becomes organized, and making the part feel tough and "doughy" to the touch. Hot packs followed by firm finger frictions around the affected part will help to re-establish normal conditions by disposing of the excess of lymph through the lymphatic vessels.

## CHAPTER IV

### OUTLINE FOR GENERAL MASSAGE; HEAD MASSAGE; WEIR MITCHELL TREATMENT; GOLDEN RULES FOR MASSAGE

MASSAGE and passive movements furnish a form of exercise for the muscular system that makes relatively light demands upon the nervous system. The removal of waste products of oxidation through the venous and lymphatic channels increases metabolism in the tissues. Decreased resistance in the peripheral vessels is the result of the acceleration of the venous flow and lymph. In addition, there is a large increase in the number of red blood-corpuscles and an exalted heart-beat without a corresponding change in the arterial tension. There is an initial rise both in arterial and venous pressure immediately following massage, but it is of brief duration. A fall of arterial pressure occurs early upon the cessation of massage, and a fall of the venous pressure follows.

It is intended in this chapter to present an outline of a general massage, and suggest approximately the length of time to be bestowed upon each part manipulated, including the movements to joints. In giving the first treatment, however, it is never advisable to use the

full time. This treatment should be given with effleurage and passive movements to each joint, and should not cover more than twenty minutes. In a case in which the patient is nervous, or may be averse to this form of treatment, it is better to start movements to joints during the second or third treatment. By this time the patient should have gained confidence in the operator and in the treatment. If there is a condition requiring more definite treatment in a certain part, more time should be devoted to that part and less to other parts. It is excellent practice for the beginner to attempt to perform the various procedures, including movements to joints, upon the upper and then upon the lower extremity, within a given time. Afterward a general massage within a fifty-minute limit may be attempted.

The patient should be encouraged in deep breathing along with this treatment, as its effect is especially beneficial upon the deeper veins and lymphatics in the thorax. In this way internal massage is promoted, and the blood and lymph are hastened toward the right side of the heart. There is no hard-and-fast rule, but the following table, stating the approximate length of time for the limbs and trunk, is given as an aid to beginners:

| | |
|---|---|
| Upper limbs | 10 minutes |
| Lower limbs | 15 " |
| Back | 10 " |
| Chest | 5 " |
| Abdomen | 5 " |

The temperature of the room in which the treatment is to be given should be not less than 65° F. The patient should be in bed and wrapped in a sheet or blanket. There is no need of exposing any part of the body other than that under treatment at the time. If there is any danger of the patient's taking cold, massage may be given under the bedclothes or, at least, under a light-weight covering. If the patient wears a night-gown, each arm should be taken from the sleeve and replaced when treated. A light-weight but warm shawl is useful to cover the upper part of the back while the lower part is being massaged. Although abdominal kneading and vibration are very helpful in cases where the patient suffers from constipation, abdominal massage, if not specially ordered, may be omitted when giving general massage. Special treatment for constipation by massage and exercise will be discussed in the chapter on Abdominal Conditions in the section on Therapeutic Exercise.

If the treatment is begun with the upper extremity, the fingers and hand are first effleuraged, friction being given around the finger-joints and to the wrist. The thenar and hypothenar eminences are kneaded by finger-and-thumb petrissage, followed by all movements to the joints of the hand and wrist. As described in Chapter I, the forearm should be effleuraged and petrissaged from the position between pronation and supination in order that the flexor and extensor muscle

groups may be grasped separately. The final effleurage of the forearm may be carried to the shoulder-joint. The flexors and extensors of the arm are petrissaged, either singly or together, with a wringing movement. This is accomplished by the alternate use of the right and left hands of the operator. Kneading and hacking over the muscles of the arm and divergent stroking over the deltoid region complete the manipulation of the upper extremity. The movements of the elbow-joint are flexion, extension, pronation, and supination. The movements of the shoulder-joint are flexion, extension, adduction, abduction, rotation, and circumduction.

The lower extremity is dealt with in much the same manner. Effleurage and petrissage of the foot, friction around the ankle-joint, flexion and extension of the toes, flexion, extension, inversion, and eversion of the ankle-joint, complete the massage of the foot.

In effleurage of the leg one hand is used over the anterior tibial and peroneal groups, the other hand stroking the gastrocnemius and posterior tibial groups. The hands are now in position for the kneading of the anterior and posterior groups. Because of the bony prominences of the anterior aspect of the leg tapotement is almost entirely confined to the posterior aspect. Effleurage in every case completes the manipulation of the part.

Effleurage of the quadriceps, adductors, and hamstrings is followed by petrissage. The latter movemen

is accomplished by the operator placing the hands side by side, the thumb of the left hand lying alongside of the forefinger of the right hand (Fig. 11). It is possible in this way to cover a larger area of the quadriceps, at the same time exerting more force in giving petrissage.

Fig. 25.—Knee pumping.

The adductors and inner and outer hamstrings are petrissaged, followed by alternate stroking and tapotement over the quadriceps femoris group. The movements of the knee-joint are flexion and extension. In cases in which there is poor circulation in the lower extremities better circulation may be established by

knee pumping. In knee pumping the leg is held at right angles to the thigh, the heel being used as a handle and the leg as a lever (Fig. 25). In this position a number of brisk (not jerky) flexion and extension movements are given to the leg. Flexion, extension, abduction, adduction, rotation, and circumduction of the hip complete the massage of the lower extremity.

As described in Chapter I, for the massage of the back the patient should be in the prone lying position. A pillow placed under the abdomen will help to relax the back muscles. The four divisions of the back are massaged in succession.

After effleurage, petrissage, and tapotement of the first and second divisions of the back are completed, those parts are covered to protect them from the cold. The third and fourth divisions receive the same treatment, except that the glutei region, being more dense, gets beating instead of hacking. The cover is now entirely removed and the final procedure of effleurage is enacted, four to six strokes being administered, and each stroke extending the whole distance from the sacrum to the acromion. Tapotement in the form of brisk tapping for its stimulating effect, or light rhythmic hacking for its sedative effect, is used, according to the needs of the individual patient. Cupping the muscles, the hands being used alternately and making longitudinal sweeps each side of the spinal column, contributes the final procedure for the back.

Effleurage and petrissage of the anterior part of the neck and of the chest are next given.

Abdominal massage consists of transverse and circular kneadings, followed by strokings of the colon from the right side up the ascending, across the transverse, and down the descending colon. Vibration, given with the whole of the palmar surface of the hand, has a stimulating effect upon the abdominal organs.

Fig. 26.—Patient in position for abdominal massage with abdominal muscles partly contracted.

If it is desired that sleep should follow massage it is wise to give abdominal massage early in the treatment. If sleep is the first consideration it is better to omit abdominal massage. Deep abdominal kneading tends to raise the blood-pressure and prevent sleep through accumulated blood in the splanchnic veins being hastened into the systemic circulation.

### HEAD MASSAGE

In cases of insomnia or if the patient is suffering from nervous headache, massage of the head is soothing and helps to promote natural sleep. The patient should be seated and the head steadied against the body of the operator, who stands behind the patient. Firm circular frictions with the finger-tips are given, covering the whole surface of the scalp. These frictional movements should have sufficient pressure to move the scalp muscles freely upon the bone. This is followed by a frictional movement, which is accomplished by a span of the radial side of the hand between the thumb and forefinger. The hands grasp the head, one on either side, the fingers and thumbs performing circular movements. The hands follow in consecutive movements from lateral to anterior and posterior positions. Light circular frictions without pressure, around the mastoid process and over the forehead and temples, will relieve local congestion. This should be followed by firm strokings from behind the ears, over the jugular veins, toward the acromioclavicular joints. A hot foot-bath during the treatment, or immediately following it, will assist in drawing the blood from the upper extremity, thus further relieving local congestion.

### WEIR MITCHELL TREATMENT

Dr. Weir Mitchell, of Philadelphia, was the originator of a treatment which is known by his name. It consist

of rest, isolation, overfeeding, massage, and electricity. The two latter are used in order to overcome the evil effects that would follow complete rest and overfeeding. The treatment usually lasts from six to twelve weeks and a general massage is given once or twice daily. This gives the student an excellent opportunity for practice. Letters as well as friends are discouraged at first, and the nurse and masseuse are the only persons that the patient is allowed to see. It is necessary that cheer and discretion accompany the mechanical part of the treatment, as the patient frequently is suffering from overwork or from mental strain. If the patient shows evidences of self-pity, this tendency should be minimized. A case of this kind requires careful handling and understanding. Massage should be gentle at first, and the vigor and length of treatment should be gradually increased. Regular and nourishing meals are given, with warm or cold milk at intervals as prescribed. Massage is usually begun within the first few days of treatment, and lasts about twenty minutes for the first time, but is increased a few minutes at each treatment until a limit of an hour or an hour and a quarter is reached. Because the patient is unable to take exercise, and because the liver is being overworked, twenty minutes of the time of treatment is spent in vigorous abdominal massage, special attention being paid to the liver and stomach. About two hours after breakfast and again between 4 and 5 o'clock in the afternoon are

good times of day for this treatment. If the patient suffers from insomnia, it is recommended that the last treatment begin at 8.30 o'clock, just before the patient retires for the night. Massage on alternate days only, with more active and resistance exercises, is prescribed toward the end of the treatment, to prepare the patient for normal living.

### GOLDEN RULES FOR MASSAGE

The student may very profitably give attention to the following counsels, which have been sometimes designated as "golden rules for massage":

1. See that the patient is in as comfortable a position as possible, and that the operator is in the best position to do the work.

2. Always support the part that is being massaged.

3. The operator's muscles should be relaxed as well as those of the patient.

4. The clothing of the operator should allow of perfect freedom and ease of movement; no sleeve should be worn below the elbow.

5. All procedures should be started moderately, increasing both in force and frequency, and should end gradually, as started.

6. Petrissage should be performed with the whole palmer surface of the hand and not with the finger-tips, except where finger-and-thumb petrissage is required to pick up individual muscles or smaller muscle groups.

*General Indications for Massage.*—All forms of functional inactivities, subacute and chronic inflammations, simple atrophy and hypertrophy of the lymphatic glands are best treated by massage.

*Contraindications.*—In skin affections (eczema, acne, and all skin eruptions), acute inflammations, tubercular cases, or any disease in which complete rest is necessary massage is contraindicated.

# CHAPTER V

## VOLKMANN'S CONTRACTURE (ISCHEMIC PARALYSIS); STIFF JOINTS; TORTICOLLIS (WRY NECK); AMPUTATIONS

CERTAIN chronic conditions and their treatment by massage and exercises will be discussed in this chapter. It is easier for the student to commence work on a chronic case. Subacute cases will be discussed in the next chapter, leading the student to the most difficult task of all—the acute. Not until the hands have become deft in treating chronic and subacute conditions, and a knowledge and insight into the pathologic changes have been acquired, should any attempt be made by the student to treat recent sprains and fractures. Until then all treatment should be left to the surgeon. Knowing that he already has his hands full, it is well for the student to study such cases from the beginning, along with the surgeon in charge of the case, in order that the patient may enjoy the benefit of early and judicious treatment.

### VOLKMANN'S CONTRACTURE (ISCHEMIC PARALYSIS)

This condition is caused by a constriction of the blood-supply of the forearm. It frequently follows a fracture of the bones of the forearm or a fracture around

Fig. 27.—Volkmann's ischemic paralysis following fracture of the humerus. With the fingers flexed the wrist can be extended. (F. J. Cotton.)

Fig. 28.—When the fingers are extended, the wrist is flexed. This is characteristic, and is the result of the shortening of the long flexor tendons always occurring in this process. (F. J. Cotton.)

the elbow-joint. If the splints were bandaged too tightly, binding the soft tissues together, and constricting the blood-vessels, the condition is liable to fol-

low which is known as Volkmann's contracture. If this paralysis is of a severe nature, it means that the median and ulnar nerves may be pinched in with the other constricted tissues. Hot packs or hot whirlpool baths, if kept up persistently, will help to soften the parts. Deep petrissage of the forearm, with firm friction around every joint in the hand and wrist, will assist in freeing ligamentous adhesions. A cock-up splint is worn over the flexors to overcome the tendency of these muscles to contract. Therefore, when this splint is removed for daily treatment, care should be taken to prevent the flexors from further contracting and thus defeating the purpose of the device. In this deformity the wrist is slightly flexed, the proximal phalanges are extended, and the distal phalanges are flexed. Splintage and treatment should aim at extension of the wrist-joint, and to gradual extension of all phalangeal joints, starting with the distal phalanges.

Operation is warranted in severe cases in which outside measures fail to give results after persistent treatment. The operation aims to free constricted tissues and to release impinged nerves. In extreme cases the surgeon may resort to splicing of the flexor tendons. Massage before and after the operation helps to obtain an earlier restoration of function. The type of treatment is similar to that given for chronic cases of fracture.

Many leading orthopedic surgeons much prefer the

appliance of the individual finger gutter splints to operation. Each finger of the affected hand is passively extended in turn and the finger splint is strapped on in order to maintain extension. The palm and the splinted finger are then bandaged to a flat metal splint. Except in mild cases the hand splint is not applied for a day or two. The wrist is extended a little each day and maintained in gain of extension by temporary massage of the arm and forearm, and finger vibration around any forearm scar is given daily. Hyperextension of the wrist and fingers is maintained until the constricted vessels are opened up. When the splints are removed for daily treatment care should be taken to forcibly stretch the phalangeal joints, one by one, the splint being replaced as each joint is stretched. The wrist receives the same care and attention.

## CHRONIC STIFF JOINTS

If injured joints are completely immobilized for any length of time adhesions and degeneration of muscular tissue will follow. Stiff joints may result from various causes—first, from a septic condition; second, from a paralysis in which nerve impulse is impaired; or from trauma, in which the joint surface is subjected to injury. In each case there is a lack of freedom in the circulation of the blood, an interference with the nerves supplying the joint, and a lack of control in the muscles that have suffered from an atrophy of disuse. More or

less profuse hemorrhage immediately follows joint injury. This effusion is likely to become organized during the immobilization period. Hot compresses or radiant heat and light, followed by firm frictions around the joint surface, assist in breaking down the adhesions. The broken-down products of inflammation are thereupon carried into the blood-stream as a result of the application of effleurage.

Passive movements are given to the affected joint along with forcible stretching in order to force the fibrinous adhesions that constrict the joint movement.

### TORTICOLLIS, OR WRY NECK

This is a condition in which the head is flexed to one side, the face rotated to the opposite side, and the chin raised. There is a shortening or constant spasm of the sternocleidomastoid muscle on one side of the neck, and a stretching of the same muscle on the opposite side. Other muscles involved are the splenius capitus, levator angulæ scapulæ, and the trapezius. The condition is either congenital or acquired. In the former instance little can be expected from manipulation or exercise. An operation is sometimes resorted to, after which the neck is put in a plaster cast. Manipulation and exercise are beneficial after the cast is removed. In the acquired type, massage and electric treatment may be used to advantage. Effleurage is applied over the anterior and posterior muscles of the neck and to the upper muscles

of the back. Finger-and-thumb petrissage is given to all the neck muscles, and a thorough kneading of all the muscles surrounding the affected area. Tapotement in the form of hacking is used over the already overstretched sternomastoid muscle in order mechanically to contract

Fig. 29.—Torticollis, showing relaxed muscles on the left side of the face and neck. (E. G. Brackett.)

the muscle-fibers, but it is omitted entirely on the contracted side.

The exercise should consist of flexion and extension of the head, lateral bending toward the stretched side, and rotation of the head toward the contracted side, thus stretching the contracted sternomastoid muscle. Positive-resistive exercises are given, in which the head

is moved toward the contracted side. The head is brought back from the contracted side to the middle position by a negative-resistive movement.

After the massage an application of electricity for about ten minutes in the form of a slow sinusoidal current is helpful in further contracting the overstretched muscles.

An ideal way of getting contractions is by using the Morse wave-generator machine. One electrode is placed over the origin of the sternomastoid, and the other one over the insertion of the same muscle. It is possible to use a Bristow coil for the same purpose, but the use of the Morse machine is preferable.

## AMPUTATIONS

In the early days of the war amputations were frequently made necessary because of infections caused by gunshot or shrapnel wounds. In cases in which there was severe infection the flapless or so-called "guillotine" operation found favor. The advantages of this operation over the more conservative methods are that it shortens the time of the operation, that it decreases the danger from infection by exposing the least amount of raw surface possible, and that, in the opinion of some, it lessens the risk of secondary hemorrhage.

Necrosis of bone, resulting in sequestra, will often be a constant source of irritation in the stump, thus preventing the stump from healing. Repeated operations

are necessary at times in order to remove the sequestra. Massage of the limb will bring the small pieces of loose bone nearer to the surface and make it easier for the surgeon to remove them.

Even before the sinus is healed, daily massage of the limb is started. Effleurage and kneading of all the muscles is given, followed by passive and positive resistance movements. Scar tissue is treated by vibratory friction. The fingers of the operator make circular

Fig. 30.—Amputation scar. A finger vibratory movement is used around the lip of the scar, always working toward the center.

vibratory movements around the lip of the scar, always working toward its center (Fig. 30). Nerves are often involved in scar tissue. If friction proves of no avail after persistent treatment, operation may be called for in order to release the impinged nerves.

Forcible stretchings are given to the muscles in which contracture is likely to develop. These are usually the flexors and the pronators in the forearm, the adductors and flexors in the arm. In the lower extremity in high amputations tendencies to flexion and abduction deform-

ity are not uncommon. All stretching should, therefore, be given with the idea of overcoming these tendencies. After treatment the redundant tissue at the extremity of the stump should be bandaged firmly with a bias flannel bandage in order to aid absorption and to prepare the stump for the fitting of the artificial limb.

Pressure exercises, from four to six times a day, should be encouraged. The patient is at first directed to press the end of the bandaged stump against a soft pillow, gradually using firmer and harder objects. In this way the stump is toughened and is prepared to act as an end-bearing surface. Perseverance on the part of the patient is the principal factor in the process of re-education after the artificial limb is fitted. In cases of returned soldiers who have undergone amputation of lower limbs a great deal has been done by regular daily drill, in which every effort has been made to encourage the men in confidence and self-reliance.

# CHAPTER VI

## SYNOVITIS; BURSITIS; TENOSYNOVITIS; SCIATICA; LUMBAGO; VARICOSE VEINS; PHLEBITIS, AND ARTHRITIS

THE subacute stage of certain pathologic conditions will respond much more readily if massage and electricity are started before the chronic stage is reached. This chapter will deal with cases of the subacute type, in which treatment by means of massage and electricity is employed as soon as the inflammation has subsided.

### SYNOVITIS

Synovitis is an inflammation of a synovial membrane. The synovial membrane of the knee is extensive; it lines the joint surface and extends from under the quadriceps tendon to the insertion of the quadriceps muscle group. The crucial ligaments and the semilunar cartilages are surrounded by synovial membrane. There are numerous superficial and deep bursæ between the muscles and tendons of the knee-joint. Following synovitis there is usually a marked atrophy in the muscles surrounding the joint, and, if measurements of the circumference of the lower part of the affected thigh are taken, they will show a considerable decrease in comparison with the normal. The treatment for any subacute synovitis is similar to that described below for bursitis.

## BURSITIS

Bursitis is an inflammation of a bursa. Because there are many bursæ in the vicinity of the knee-joint any injury in this region is likely to set up an inflammation. The prepatellar bursa is the most common site of injury. This bursa does not communicate with the knee-joint. Prolonged kneeling or a fall or blow on the knee is apt

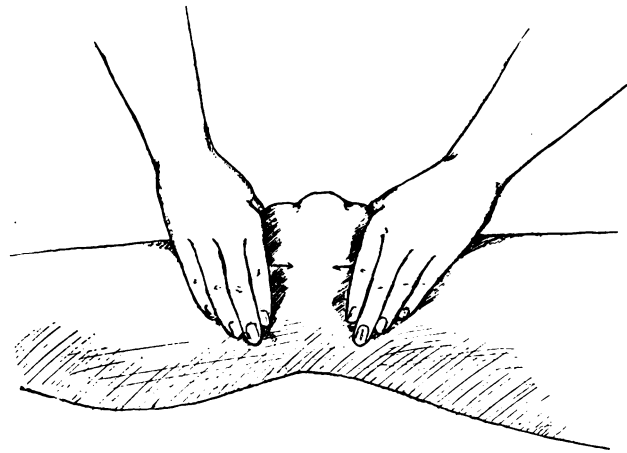

Fig. 31.—Squeezing and pressing above and below the inflated area will aid absorption of fluid in a subacute condition.

to cause a swelling of the prepatellar bursa, resulting in a bursitis. In the acute stage treatment calls for rest and the application of ice-packs or hot fomentations until the inflammation has subsided. Afterward deep pétrissage of the proximal area, and squeezing and pressing of the inflated part, will aid in the absorption of the excess of fluid. This squeezing movement is made by

one hand of the operator spanning the thigh transversely above the patella, the other hand spanning the upper part of the tibia just below the patella. Squeezing and pressing of the tissues so that the hands are brought toward each other is followed by the final effleurage (Fig. 31). Great care should be taken to see that no direct pressure is exerted over the patella lest a recurring inflammation should be induced and the purpose of the treatment be defeated. Not until the heat is reduced and the pain relieved are gentle passive movements of the knee-joint started. Gradually these movements are increased until the patient is encouraged actively to flex and extend the knee. Resistance exercises are given later in order to strengthen the atrophied muscles, especially those of the quadriceps group.

After manipulation the faradic current in the form of the Bristow coil in the subacute stage is excellent. Careful technic in the administration of this current is essential in order not to overexercise any of the muscles. In a synovitis as a consequence of the joint injury there is not only an atrophy of disuse of the muscles that control the joint movement, but there is also a reflex atrophy because the nerve that supplies the muscles also supplies the joint. The vastus internus muscle, as a rule, shows more marked atrophy than the other muscles of the quadriceps group.

The Bristow coil is used over each muscle in turn for one or two minutes at a time. Its principle is to imitate

closely the normal contraction of muscle action. The regulation of the wave of contraction to the muscle is performed by the right hand of the operator. The iron core of the coil is pushed to the maximum of contraction which may be borne by the patient, and is withdrawn for the relaxation of the muscle. First, the current is used for one or two minutes upon the vastus internus, next for the same length of time upon the rectus femoris. On the external aspect of the thigh similar contractions are administered upon the vastus externus and over the tensor fasciæ latæ. The latter supports the body weight in the upright position with minimum effort; therefore it is essential that this muscle should not be overlooked when contractions are encouraged in the other muscles of the thigh. Care should be observed not to stimulate the inner part of the thigh near the insertion of the sartorius muscle, as this muscle reacts more readily to stimulus, and overstimulation is apt to cause pain.

In the chronic stage of bursitis fibrinous deposits upon the walls of the bursæ are likely to be present, and adhesions are somewhat fixed because the organized products of inflammation have been allowed to remain. Firm circular frictions around the patella in order to break down adhesions, and heavier manipulation throughout, is called for in all chronic cases; otherwise the treatment is much the same as in the subacute form.

## TENOSYNOVITIS

Tenosynovitis is an inflammation of a tendon and its sheath. It is not unusual to find an inflammation in the foot behind the heel. The usual causes are strain of the tendon or undue pressure of the shoe. If it is from pressure of the shoe, this must be entirely relieved. A thick piece of felt, with a hole cut in the center and applied to the inflamed part of the heel, will act as a protection from the pressure of the shoe, the pad being strapped or bandaged to the heel. The treatment, after the inflammation has subsided, is massage of the gastrocnemius muscle, and passive and positive resistance exercises to the ankle-joint, in order to strengthen the muscles that have atrophied as a result of the inflammation.

## SCIATICA

Sciatica is pain or neuralgia of the sciatic nerve, or perineuritis of the nerve trunk. It is frequently caused by exposure to cold or dampness, or by pressure from within the pelvis.

The treatment by massage and exercise is started as early as possible after the acute stage. During this stage hot packs are applied over the glutei region and along the back part of the thigh, and the patient is confined to the bed, with the affected limb relaxed and surrounded with pillows and hot-water bags. After the acute inflammation has subsided it is well to have the limb flexed and to effleurage from the toes to the origin

of the glutei muscles. Referred pain along the course of the sciatic nerve is not at all unusual. All the muscles of the leg and thigh are thoroughly pétrissaged and deep vibration is given along the course of the sciatic nerve from the great sciatic notch, where the nerve issues from the pelvis to the terminal branches in the

Fig. 32.—Stretching of the sciatic nerve.

foot. Passive movements follow manipulation, and, if there is no fear of recurring inflammation, the leg is well stretched. In order that this may be done the patient should be in the supine lying position, the knee held stiffly. The operator slowly flexes the limb on the thigh, to the limit of the patient's endurance. From this

position the final stretch is given to the sciatic nerve by dorsiflexing the foot (Fig. 32). If a spastic contraction of the posterior thigh muscles exists, straight leg raising may help to overcome this spasticity.

In the subacute stage the application of the galvanic current, used either preceding or following manipulation, has proved of great advantage in many instances. The foot of the affected limb is placed in a foot-tub half-filled with warm water. The positive rheophore is attached to the tub, and acts as the positive electrode. The negative electrode is well soaked in warm water or a warm solution of sodium chlorid, and is placed directly over the sacral plexus. From 10 to 20 milliamperes of constant current is used, and the treatment should last for about twenty minutes.

## LUMBAGO

Lumbago may be the outcome of overstrain of the muscles in the lumbar region. Pain, tenderness, and stiffness are felt over the sacrum at the insertion of the lumbar muscles, and especially so when the patient attempts to move. The strain sometimes seems to go as deep as the sacro-iliac joint; even the sheath of the sciatic nerve may be affected over the region of the sacrum.

Heat is applied either by means of a radiant light or else with a high-frequency current given with a non-vacuum electrode, or by the application of diathermy.

In the subacute stage, following the application of heat, the lumbar muscles are stroked and gently kneaded. When the pain has entirely subsided light beating of the affected region may be added. The vigor of the manipulation is increased gradually, but should never be strong enough to be painful to the patient. Exercise should be omitted from this treatment until the pain has entirely disappeared. Then usually the patient complains of stiffness in the lumbar muscles. Active exercises, in which the patient is encouraged to raise the trunk to the sitting position from the supine lying position, are about the best form of exercise to reach this particular condition.

In the type of sciatica or lumbago in which the pain is not caused by a sacro-iliac strain, but is a myositis, vigorous vibration has frequently been used to excellent advantage. The treatment is given by means of an electric vibratode, used over the most cutaneous branches of the nerves and over the affected muscles for twenty to twenty-five minutes, followed by static sparks for five to eight minutes. A sedative effect is nearly always gained, inhibition being the outcome of the pressure and fatigue of the treatment.

### VARICOSE VEINS

In these cases the walls of the veins are distended and the valves become unable to accomplish their work, so that regurgitation of the blood occurs in the

veins. At times the veins become so overgorged that they look like knotted purple cords. All constriction by garters should be relieved. The patient should endeavor to rest the lower extremities as much as possible on an inclined plane, for this helps the venous circulation. When the acute inflammation has subsided, and then only with the greatest care, light stroking should be administered. No pressure is exerted over the beaded veins, but the collateral circulation should be encouraged. Kneading of the thigh opens up the veins and lymphatics in the proximal region. Light stroking below the knee, with very careful knee pumping, should follow. The limb should be well raised during the treatment, and the patient should always rest for at least twenty minutes after the treatment. Firm, even bandaging will act as a steady pressure on the walls of the peripheral veins.

## PHLEBITIS

Phlebitis is an inflamed condition of a vein which may follow as a result of typhoid fever, pneumonia, and appendectomy, and is often found following childbirth. Phlebitis is commonly associated with thrombosis. Puerperal sepsis may result in thrombophlebitis of the iliac and femoral veins. The danger in a case of the latter is in dislodging the thrombus. The greatest care should be taken that no pressure is exercised over the area of the large veins of the thigh. In a case of phlegmasia alba dolens no massage should be commenced

until at least two months after the acute stage; then only strokings of the gentlest nature should be given, and when the muscles of the patient are relaxed. Very quiet passive movements to the ankle- and knee-joints follow manipulation. The technic in such cases, accompanied with the knowledge of microscopic and pathologic changes in the veins, should be understood before such delicate work is attempted; otherwise much damage may be wrought.

### ARTHRITIS

Arthritis is an inflammation of a joint. An acute inflammation is at all times a contraindication for massage. If the patient who is suffering from arthritis could be brought to the physician or to the hospital clinic in the beginning of the acute stage before the well-developed pathologic changes of the chronic condition have taken place, much trouble would be avoided. The various types of arthritis and their treatment by physical methods are discussed below. In all chronic forms of arthritis the operator should know to which general classification the case belongs. The muscles above and below the affected joints should be gently kneaded, so that the metabolism may be improved. Except in the osteo-arthritis type friction around the joints is helpful. Movements to joints should always be performed with the greatest care in order that no further irritation may be developed in the joint. Many and

varied theories of the nature of arthritis have been propounded during the last quarter of a century. The medical profession is turning more than formerly to physical therapeutic methods in the treatment of such cases. Almost all authorities agree that instead of first treating the symptoms, a thorough search should be made in order to trace the etiologic cause, and remove that if possible. If the case can be taken while yet in the early stage or in the early part of the subacute stage, a better prognosis can be assured.

The theory that in the atrophic type there is an excess of calcium from the bone is quite generally accepted, and it is also believed that trauma to the joint has a good deal to do with the advancement of the hypertrophic type. Preisor's theory is that the weight-bearing surfaces, as, for example, those of the knee-joint, are apt to show signs of degeneration when faulty positions are habitually assumed.

Doctor Goldthwait, in his classification, describes three kinds of arthritis—the infectious type, the atrophic type, and the hypertrophic type.

In infectious arthritis the infection may be focal, as around the teeth, in the tonsils, or in the intestinal tract. Tubercular, gonorrheal, or syphilitic infections are not uncommon causes, or the infection may be so obscure that the source is difficult to determine. The source of infection should be removed or treated, as the case may require. The tissues suffer because of the infection within

the joint, and from the atrophy of disuse. A joint affected by gonorrheal arthritis is sometimes put in a cast. When the cast is removed, hot packs, and friction around the edematous region and effleurage of the whole limb, with gentle passive movements to the joints, constitute the treatment.

Atrophic or rheumatoid arthritis is not supposed to be of an infectious nature. It is possible that there is some neurotrophic disturbance. There is no fear of stirring up infection from movements to joints as in the preceding infectious type. If massage and exercise are started early, considerable improvement may be expected. Effleurage and pétrissage are used to increase metabolism in the muscles. Active and positive resistance exercises are also given for the purpose of strengthening the muscles.

Hypertrophic arthritis, commonly called osteo-arthritis, or arthritis deformans, is the most serious type of all. Little can be done except to keep the degenerative processes as inactive as possible. There is a disintegration of articulating surfaces. A careful study of the diet is an important factor. If the pathologic condition has not progressed too far, gentle massage, if continued persistently for a considerable period, may prevent ankylosis of the joints. Light resistive exercises are better adapted to this condition because they exert less pressure upon the intra-articular surfaces. The patient should be encouraged to take daily walks out of

doors, being most careful to avoid getting damp. A warm, dry climate and light woolen underclothing are advised in such cases.

In the chronic form of arthritis, which is so usual, the operator should know to which general class the case belongs. The muscles above and below the arthritic joints should be pétrissaged in order to increase metabolism and to help to keep the muscles in better condition. Very careful friction around the joints, followed by the most gentle forms of passive movements, should be administered. Great care should be taken that no irritation is started up in the joint by rough handling or jerky movements of any kind.

In the United States Army Hospital at Lakewood, N. J., and at the United States Army Hospital, No. 41, Staten Island, New York, static electricity was used with much success in the treatment of arthritis. The DeKraft blue pencil effluve, the spark, and the Morton wave were the static modalities employed. The current was applied to the affected part for the purpose of helping to disperse the organized products of inflammation, and to open the venous and lymphatic channels, and so allow the broken-down residue to be carried off through the circulation. In chronic conditions in which calcium deposits were present the stiff joints were treated by means of thermopenetration, or by ionization with a solution of sodium chlorid, before the static current was used.

# CHAPTER VII

## THE NERVOUS SYSTEM: FUNCTIONAL DISTURBANCES—NEURALGIA, NEUROSIS, NEURASTHENIA; ORGANIC DISTURBANCES—NEURITIS, PARESIS

In a functional disturbance there is a derangement of the normal activity of an organ, but no change in its structure. In an organic disturbance there is a structural change in the affected part the result of disease of an organ or of a part of the body.

Functional and organic nerve disorders and their treatment by means of physical therapeutic methods will be discussed in the three following chapters. In functional disturbances electricity in combination with massage and exercise is much favored. In organic disturbances individual muscle and muscle group training for the restoration of function of the impaired muscles is valuable. Exercises also of re-education play an important part in the treatment of cerebrospinal types of paralysis.

### Functional Disturbances

#### NEURALGIA

Neuralgia is pain in a nerve. It may be of cerebral, spinal, or visceral origin. The seat of pain is not always identical with the seat of the pathologic condition. Referred pain, or paroxysms of pain, are not at all unusual. Tenderness is often felt in the area supplied by

the most superficial branch of the nerve. Dampness, cold, extreme fatigue, or injury from a blow are the most frequent causes of neuralgic conditions. The most common forms of this disturbance are intercostal neuralgia and neuralgia of the trigeminal or fifth cranial nerve (tic douloureux). In the former, gentle effleurage and kneading over the affected area is helpful in severe or recent cases. If friction or vibration is used over painful points, it should be administered with firm, continuous pressure. This will sometimes react in a decidedly sedative manner. In the subacute or in chronic conditions, deeper and heavier treatment throughout is indicated.

Sometimes the application of electricity is used. In the acute stage, the static brush, over the affected area, is helpful. In the subacute stage a solution of sodium salicylate is driven into the tissues by means of the constant current. In ionization the negative electrode is soaked in a 2 per cent. solution of sodium salicylate and placed over the affected part. The indifferent electrode may consist of the attachment of the positive electrode to a foot-tub of warm water. This treatment should last from twenty to thirty minutes, 3 to 15 milliamperes of current being used. If the pain is on the left side of the chest in the precordial region, great care should be observed in watching the pulse of the patient, and no sudden change should be made in the strength of the current.

In the most common form of neuralgia, when the fifth cranial nerve or its divisions is affected, facial massage may be of appreciable benefit. Effleurage and finger-and-thumb pétrissage of all the muscles of the face is given, followed by finger vibrations over the three cutaneous branches of the trigeminal nerve. The index-finger is made to vibrate firmly first over the supra-orbital nerve; second over the infra-orbital nerve; and third over the most superficial part of the inferior maxillary division of the fifth cranial nerve that lies between the angle of the lower jaw and the middle line of the face. Effleurage of the face completes the treatment, the strokes being carried with each hand from the middle line of the face to beneath the lobe of the ears.

## NEUROSIS

A neurosis is a functional nerve disease. It is an affection of the nervous system in which there is a marked functional disturbance occurring without any apparent cause. Disease is inconceivable without some underlying physical basis. The lesion need not be visible even microscopically; it may be either of molecular or of biochemical origin. There have been many cases of functional war neurosis, which have completely cleared up with intelligent care. In cases in which functional paralysis was present function was gradually restored by the encouragement of some occupational or vocational activity, in combination with some form of

outdoor sport. Along with the activity, regular systematic treatment, consisting of massage and the Bristow faradic or the sinusoidal currents over the affected muscles, have been used to advantage. This treatment encourages nutrition in the muscles and closely imitates normal muscular action. If contractures are present, stretching of the muscles and splintage between treatments will aid in restoring normal function.

## NEURASTHENIA

Neurasthenia is a result of the exhaustion of the nerve-centers. There may be a disturbance in the motor mechanism, resulting in inability to perform definite muscular actions; in the sensory equipment, resulting in hypersensitivity to heat and cold; or in the autonomic system, resulting in gastro-intestinal trouble. The close relationship existing between the cerebrospinal and autonomic systems is such that disturbance in one must naturally affect the other. Physical therapeutic measures are often more effective than any other kind of treatment. The modified Wier Mitchell treatment, as described in Chapter IV, is frequently prescribed for neurasthenic patients. Daily treatments of massage are given in combination with electricity. By using the sinusoidal current or the faradic current of the Bristow coil contraction of the various muscle groups in the upper and lower extremity are obtained.

## ORGANIC DISTURBANCES

### NEURITIS

Neuritis is an inflammation of the nerve and of its peripheral endings. Infectious diseases and toxins often produce this condition. There are three distinct stages of neuritis—the acute, the convalescing, and the regenerative. No massage is indicated in the acute stage. Rest and warmth are essential. The application of the cobalt-blue light over the affected area for ten to fifteen minutes has been found to have a sedative value both because of the light and the color of the light. Only with the greatest amount of care and gentlesess should massage be given in the convalescing stage. In the regenerative stage, however, the sooner the affected part receives massage and passive exercises, the better. In the subacute stage of a brachial neuritis the application of electricity in the form of the constant current is made either directly before or after massage.

For the negative electrode a large well-soaked pad extending from the wrist to the elbow-joint is placed over the brachial plexus and the positive electrode is placed on the arm. From 2 to 12 milliamperes of constant current are given for from twenty to thirty minutes.

### PARESIS, WRITER'S CRAMP

Paresis is a partial paralysis, often resulting from some such form of muscle fatigue as writer's cramp, and is found in persons of a nervous temperament who are

overworked. Complete rest from the occupation which employs the fatigued muscle groups should be insisted upon from the beginning of the symptoms of fatigue. In writer's cramp, kneading and effleurage of the affected arm are beneficial, and special attention should be paid to the posterior muscles of the forearm. Gentle passive movements to the wrist- and elbow-joints are given from the start. A little later, passive and assistive movements, followed by positive resistance movements, are applied to the extensors and abductors of the thumb. Short treatments twice daily are to be preferred.

In the acute stage rest and the application of diathermy has been found of great advantage. For three or four treatments at the first the penetrating heat has a sedative effect as well as flushing the part with fresh blood. From 300 to 600 milliamperes of current is used for thirty or thirty-five minutes daily. After several treatments of this kind massage of the limb may be added, preceded by twenty minutes of diathermy. In the recuperative stage the positive pole of the constant current may be used to great advantage. The indifferent electrode is placed at the back of the neck, and the positive or active electrode is placed on the affected muscles.

# CHAPTER VIII

## THE NERVOUS SYSTEM (Continued)

## ORGANIC DISTURBANCES—PARALYSIS, CEREBROSPINAL: SPASTIC (HEMIPLEGIA AND LOCOMOTOR ATAXIA), FLACCID (INFANTILE PARALYSIS)

### PARALYSIS, CEREBROSPINAL

PARALYSIS is the result of some lesion or injury either in the brain, the spinal cord, the nerve trunks, or in the terminal branches of the nerves. The lesion interferes in some way with the transmission of the nerve impulses. Paralysis of cerebral origin is almost always of the hemiplegic type, because in this form one side of the body only is affected. Paralysis of spinal origin usually affects both halves of the cord, resulting in a paraplegic condition. In general, paralysis may be divided into the spastic and flaccid types. Hemiplegia is an excellent example of the spastic type, being an affection of the upper neurons. Infantile paralysis is an excellent example of the flaccid type, being an affection of the lower neurons.

### SPASTIC PARALYSIS

The characteristics of spastic paralysis are an increase of reflexes and hypertonicity of certain affected muscle groups which is the result of interference with the inhibitory centers. The affected muscles show no "re-

action of degeneration." This form of paralysis is of the non-atrophic type, as the upper neurons do not control nutrition. Adult hemiplegia is often the result of cerebral hemorrhage or it may be caused by cerebral embolism or thrombosis. The hemiplegia cases in army hospitals were usually the result of gunshot wounds or shrapnel wounds in the head. Injury to the gray matter destroys the originative and the receptive centers. An injury to the white matter destroys the path to and from the centers. The motor centers of the foot, leg, arm, and face are situated in the cortex in the precentral area which lies in front of the fissure of Rolando. The speech is frequently affected in the early stages of the attack, but, as a rule, it generally returns.

A right-sided brain lesion results in a left-sided paralysis, and vice versa. Treatment is calculated to reestablish muscle habits; therefore the aim is to encourage voluntary motion of the relaxed muscle groups. In the upper extremity the muscles in which relaxation is usually most marked are the upper fibers of the trapezius, the posterior fibers of the deltoid, the extensors and outward rotators of the arm, the extensors and supinators of the forearm, and the extensors of the wrist and fingers. In the lower extremity the muscles in which relaxation is most marked are the gluteus maximus, the abductors and inward rotators of the thigh, the extensors of the leg, and the dorsiflexors of the ankle-joint. The quadriceps extensor group is not, usually,

as relaxed as the other extensor muscles because of the patient's effort to hold the leg straight while walking. The action of the rectus femoris not only extends the leg but also, on account of its iliac origin, it flexes also the thigh on the trunk.

In the early stage of hemiplegia, if the cause of the trouble is the bursting of a minute blood-vessel, or embolism in the brain, no treatment should be administered until it has been ordered by a physician. When the danger of a recurrence of bleeding is passed, in about two or three weeks' time after the attack, deep quiet kneading of the muscles and gentle passive movements are indicated. There should be no tapotement or active exercise at this stage. Only in the later convalescing period should the more strenuous activities have consideraton. In this period voluntary exercises, involving upper-neuron training, and having muscle balance for their object, are of far greater value than massage. Stroking over the entire limb of the affected side prepares the way for transverse hacking across the muscle-fibers of the relaxed muscle groups. This manipulation helps mechanically to contract the muscle-fibers. It is useless to try to stretch the contracted groups, because greater contractility will result. The patient should be compelled to make use of the relaxed muscle groups. Prescribed exercises, especially those of a competitive nature in the form of games, are of great value.

A table of Dr. Sheperd Ivory Franz's exercises for hemiplegics is given in detail in Part II, Chapter VIII. These exercises have been tried at Reed College Reconstruction Clinic in Portland, Oregon, and at the Walter Reed General Army Hospital in Washington, D. C., and have proved to be of great value.

### TABES DORSALIS

Tabes dorsalis is a common type of degeneration of the posterior roots, of the spinal cord, and sometimes of the spinal ganglia. It is characterized by a loss of reflexes, a loss of sensibility in certain areas, and a loss of sensibility in the muscles and joints, which causes the patient to walk with a peculiar gait. There is frequently a hyperextension of the knee-joint because of a lack of muscular balance in the limbs.

For this form of paralysis all exercises should be of compensatory nature. Doctor Frenkel has developed a so-called "compensatory-exercise therapy." The patient watches his own actions, both in the sitting and standing positions, then closes his eyes and repeats the exercises. Little or no apparatus is necessary. This calls for ingenuity on the part of the operator, and for special work with each individual. Frenkel's exercises are given in detail in Part II, Chapter VIII.

### LITTLE'S DISEASE

Spastic paralysis of children follows some lesion which may possibly occur at birth. There is usually a rigidity

of certain muscle groups. As a rule, the spastic condition is more often found in the legs than in the arms. Although there is no atrophy of the muscles, movements are inco-ordinate. The gait is often spastic, and in some cases the child is unable to walk.

All treatment should aim to strengthen the muscles. Therefore, a general massage is of advantage, followed by exercises to improve co-ordination. Exercises should be of a simple nature, and performed slowly and correctly. Imitative exercises are of value. In these exercises the patient is asked to perform a simple movement while watching the movement being performed upon the opposite limb by the operator. Picking up a small object with the toes and placing it on marked squares and circles is helpful and holds the child's interest. Any exercise in game form that will aid co-ordination and help to improve the patient's mental condition will be of advantage.

### FLACCID PARALYSIS

Flaccid paralysis is known as the lower neuron type, in which there is a lesion of the lower neuron. Its characteristics are a decrease or loss of reflexes, with flaccid muscles, or a hypotonicity of the muscle groups controlled by the affected neurons. The affected muscles show "reaction of degeneration."

Infantile paralysis is a common example of the flaccid type. It is an acute infectious disease. The probable

port of entry of the infection is through the upper respiratory tract, through which the bacilli pass into the blood-stream and attack the spinal cord. The first pathologic stage of the disease is an acute interstitial meningitis, which is usually more marked in the anterior horn of the spinal cord, in which the blood-supply is more abundant. The cervical and lumbar enlargements of the cord are most often affected. The damaging effects are to be attributed in part to direct pressure on the nerves of hematoma, edema, and exudate; to anemia, following constriction of the blood-vessels; and to direct toxic action of the virus itself on the nerve-cells. The nerve-cells degenerate on account of the pressure and anemia. If nature absorbs the hematoma and exudate soon enough, thus relieving the pressure, the cells may recover function; if, however, the unfavorable conditions are too prolonged or too excessive, the nerve-cells may undergo complete degeneration. Epidemics of infantile paralysis are most common during the summer months in child life.

There are three stages of this disease—the acute, the convalescing, and the chronic. In the acute stage rest, warmth, and medical care are necessary until the acute inflammation has subsided. Not until the later period of the convalescing stage, when all fear of the return of inflammation is passed, should massage and exercise be started. This treatment, however, should be well under way before the chronic stage is reached. Every pre-

caution against deformity should be taken, especially by the use of apparatus to maintain the normal position of the limb. Massage, especially pétrissage of the limb, keeps up the nourishment of the muscles while the nerve tracts are being regenerated. Operative measures are not contemplated until nature has been given a fair chance to recuperate. Massage and muscle training should be continued for two years or longer during the recuperative period. Should tendon transplantation be resorted to, massage and assistive exercises followed by positive resistive exercises directed to the relaxed muscle groups, which are exercised at the expense of the antagonizers, will help to produce the desired results after an operation. With constant persevering re-education of muscle groups the balance of muscle play may sometimes be restored before structural deformity takes place. This necessitates an understanding on the part of the operator of the deformities that may result from the contraction of certain muscle groups, but which may be prevented if proper attention is given early enough in the treatment. An equino-varus condition of the foot is a very common deformity that follows infantile paralysis. If the patient can be taught to stretch the tendon of Achilles systematically, a possible deformity may be prevented. When any stretching of muscles is given no forcible pull should be exerted, but a series of intermittent pulls. Parents should be encouraged to take an

intelligent interest in the treatment. Usually, after many months of attending clinics, they either get tired of coming or lose interest.

Fig. 33.—Showing deformity of right side following infantile paralysis, atrophy of lower limb, and equino deformity. (E. G. Brackett.)

In infantile paralysis, when the nerve-cells of the anterior horn have not completely undergone degenera-

tion, and new nerve tracts are being established, muscle training is of the utmost value, especially if treatment is started before the unopposed muscles pull the bones out of position and cause deformities. Frequently the extensors of the upper extremity, the extensors of the leg, and the dorsiflexors and everters of the foot are the relaxed groups. Graded assistive exercises provide a foundation for muscle training if the patient has sufficient voluntary power to co-operate. Much skill is necessary on the part of the operator in the adjustment of these assistive movements. Voluntary impulse should be emphasized and care should be taken to avoid muscle fatigue. During the regenerative period everything possible should be done to maintain nutrition in the limb.

Dr. Robert Lovett, of Boston, gives three general types of exercise:

1. Those in which gravity assists the movement. This is the easiest form of exercise.

2. Those in which gravity is eliminated. This type of exercise is performed with the limb supported in the side-lying position.

3. Those performed against gravity. This is the hardest type.

If voluntary impulse is lacking, and the re-establishment of muscle tone is the first consideration, the easiest type of exercise for the patient should be used. As it is not always possible to have the assistance of gravity in

certain muscle groups, the side-lying position with gravity eliminated is most useful. If there is no response at first, then passive movements are given until some sign of muscle response is detected, whereupon assistive exercise takes the place of passive.

The following table offers a practical classification of the varying degrees of disturbed muscle response:

1. Gone. In this class there is no response on attempt at movement.

2. Trace. No movement is possible, but a trace of contraction is felt in the tendon.

3. Poor. The muscle is able to perform a part or all of a normal movement, but is unable to perform a movement against gravity.

4. Fair. The muscle is able to perform a movement against gravity.

5. Good. The muscle is able to perform a movement against both gravity and outside resistance.

6. Normal. Normal muscle action is attained.

If there is paralysis of one side of the trunk muscles, spinal curvature follows as a result of the unaffected muscles asserting themselves. The pull on the spinal column causes a lateral curvature of the spine.

For up-to-date study of infantile paralysis and muscle training Dr. Lovett's book on this subject should be studied. This method of training individual muscles or muscle groups has been found very effective. In adult poliomyelitis massage and the same assistive exercises

are used to encourage the return of function of the paralyzed muscles.

A brief outline of exercises in muscle training and their application is given below. Take, for example, a convalescing case of infantile paralysis in which there is fair or poor muscle action in the dorsiflexors of the toes and ankle-joints and in the muscles that draw the sole of the foot inward. At the same time the extensors of the leg and the flexors of the hip show fair or poor response of muscular action.

The muscles chiefly affected are the extensor proprius hallucis, extensor longus digitorum, extensor brevis digitorum, and the lumbricales of the toes; the extensor proprius hallucis, extensor longus digitorum, tibiales anticus and posticus, and the flexor longus hallucis of the foot; the quadriceps extensor muscles of the leg; and the psoas, iliacus, rectus, sartorius, pectineus, and the adductor longus and brevis of the thigh.

To perform the exercises for the phalangeal and ankle-joints the patient should assume the prone lying position, with the knee flexed at right angles and the leg directed vertically upward. The leg above the ankle-joint is grasped by the operator and the patient dorsiflexes the toes and ankle, gravity assisting the movement. When the muscles are capable of movement against gravity the patient is seated with the leg, from the knee, hanging over the edge of the plint or table. The operator steadies the leg by grasping it above the

ankle and the patient dorsiflexes the toes and ankle. As a mark of progression the operator may add resistance across the toes and dorsal surface of the foot during the movement. The exercises for the valgus tendency are best performed from the side lying position. The patient turns the foot upward and inward; from this position gravity is eliminated. As soon as the muscles are capable of motion against gravity the patient should be seated and the same inward and upward ankle movements performed. Resistance by the operator marks progression. When braces are no longer necessary, tip-toe walking and balance exercises are useful.

To exercise the quadriceps extensor group the patient lies on the affected side with the knee flexed at right angles; the leg is extended until it is straight with the thigh. The operator may give assistance by gently aiding the movement. As soon as movement against gravity is possible the patient sits with the legs hanging over the edge of the table and extends the leg. Later, resistance by the operator may be given.

To exercise the flexor muscles of the hip the patient lies on the affected side, the opposite limb being supported and held out of the way; the hip is flexed by bringing the knee up to the chest. Assistance may be given by the operator from the posterior part of the thigh. Resistance may be added as improvement in muscle action is noted. The supine lying position also is assumed and the patient brings the knees to the chest,

the operator steadying the affected knee during the movement to prevent the leg from twisting. If the hip is flexed and the whole leg brought forward with the knee straight both the flexors of the hip and the extensors of the leg are exercised at the same time.

# CHAPTER IX

## THE NERVOUS SYSTEM (Continued)

## PARALYSIS, PERIPHERAL: MUSCULOSPIRAL, ULNAR, MEDIAN, SCIATIC (EXTERNAL AND INTERNAL POPLITEAL), FACIAL

### PERIPHERAL PARALYSIS

THIS may be caused by disease, but more frequently is the result of injury in the course of the motor nerves. As well as a lack of voluntary movement in the affected muscles, there is usually an accompanying change in sensation. This sensory disturbance corresponds to the distribution of the affected nerve to the skin. Peripheral lesions of the nerves of the brachial plexus and the sacral plexus, and their treatment by massage, and especially muscle training, is discussed.

Peripheral lesions may result in sensory and motor disturbances, with loss of reflexes. In gunshot wounds the whole cross-section of the spinal cord may be affected, or one tract only. There may be a lesion of the posterior horn with its accompanying sensory disturbance, causing ataxia. In a sensory disturbance all movements must be entirely brought about by the patient's own volition. The exercises should be definite, slow, and rhythmic, the operator encouraging a full arc of movement. This helps to re-establish habit

formation through reflex action, and so improves co-ordination.

Peripheral nerve disturbances are of four types: (1) Those in which there is complete anatomic interruption; (2) those in which there is physiologic interruption; (3) those in which there is compression, the nerve being bound in scar tissue; (4) the irritative type, those in which the nerve is injured, but not divided. The accompanying symptoms vary in each of the above types of paralysis. The sensory disturbance also differs; the anesthetic area in a complete interruption does not improve, while in a partial or compression paralysis this area may improve and even disappear entirely. In the irritative type there is a marked hyperesthesia and hyperalgesia. Trophic disturbances are found in all types of paralysis, but are not necessarily present. Trophic disturbances are more pronounced in the irritative type, and often accompany the partial and compression paralysis. Trophic ulcers and pressure sores are more frequently present in the sciatic lesions. The heel and the external malleolus show this to a marked degree.

The action of the sudoriferous glands throughout the distribution of the affected part is either increased or decreased. In many of the nerve-lesion cases that were treated in army hospitals massage and muscle training were started as early as possible in the hope that these agencies would render assistance during the regenerative period. When signs of regeneration did not appear

after many months of watchfulness, operative methods were frequently resorted to in both the irritative and compression types. The nerve was freed from binding fascia and tendons or from hard bony surfaces. Within a very short time after the operation massage for the muscles and movements to the joints was prescribed.

In a partial or complete interruption of the nerve neuromas are often removed and nerve-suture operations performed. After operation the tension of the muscle groups in which nerve regeneration is taking place is entirely relieved by placing the limb in a cast made in two parts, so that the anterior part may be removed for the administration of treatment. A brace is often substituted in place of the cast in about ten days' time, and massage and muscle training are started. Following a sciatic or external popliteal nerve suture the limb is gently and regularly stretched by gradually decreasing the degree of flexion of the limb by the application of a new cast. Nerve-grafts are used if nerve-fibers are shot away to a great extent, or if it is necessary to remove a long piece of nerve-fiber because of necrosis of nerve substance. This is a last resort.

If there is a gunshot or shrapnel wound in the region where all three cords of the brachial plexus emerge from beneath the clavicle, complete paralysis of the brachial plexus is liable to be found. In many cases of peripheral nerve lesion the idiomuscular reflex is increased; especially is this so in the early period of regeneration.

### MUSCULOSPIRAL PARALYSIS

Musculospiral, ulnar, and median types of paralysis result from injury of the different cords of the brachial plexus. The musculospiral has been the most common type of paralysis found among army cases following injury of the arm. Frequently a gunshot or shrapnel wound in the outer portion of the upper third of the arm will result in a musculospiral paralysis. Because of the extensive distribution of this nerve and of the nu-

Fig. 34.—Wrist-drop deformity in musculospiral paralysis. After each treatment the wrist extension splint is worn.

merous muscles which it supplies there is danger of deformity of the hand, the typical symptom of which is "drop-wrist," unless great care is taken during the regeneration of the nerve. A splint should be worn to support the muscles during the regenerative period. If the nerve lesion is slight and if the muscles supplied by this nerve are kept in good condition, massage and passive and assistive exercises of the joints will materially assist the muscles in gradually regaining their nor-

mal function. Once nerve regeneration is well under way, final recovery may be expected, provided the atrophy of the muscles is not allowed to progress.

If the lesion is above the insertion of the triceps, the extensors of the arm are the first to regain their function. The extensors of the wrist on the radial side, because of a greater muscular distribution, show signs of recovering their power of action earlier than those on the ulnar side. If assistance is given by the operator in extension of the first phalanges, where they articulate with the metacarpal bones, then the patient is able by his own volition to extend the second and third phalanges. This action is not controlled by the extensor communis digitorum, which is supplied by the musculospiral nerve, but rather by the posterior interossei and the terminal slips of the lumbricales, which together form an aponeurotic tendon and extend the second and third phalanges, the extensor communis digitorum playing only a minor part in the extension of the last two phalanges.

The treatment for a musculospiral paralysis should consist of a daily massage of the entire limb, preceding special kneading of the muscles on the posterior surface of the hand, forearm, and arm. A soft roll placed in the palm acts as a support to keep the wrist in extension during manipulation. From six to eight muscle contractions are given and from 7 to 10 milliamperes of interrupted galvanic current are used over the motor

points of the affected muscles. The negative pole is the active electrode and is placed on the motor point of the affected muscles. This, following massage, will aid in muscle contractions if voluntary nerve impulse is lacking. In all cases in which there is a complete (R. D.) reaction of degeneration the positive electrode is the active one until some response to the negative pole is felt. As soon as nerve response is manifest the slow sinusoidal current or the Bristow coil is substituted for the interrupted galvanism, two or three minutes being spent upon each muscle group. Exercises are given in extension of the metacarpophalangeal and wrist-joints. Supination of the elbow-joint follows. For all passive and assistive exercises the forearm should be placed in the side-lying position. In this way the pull of gravity is eliminated.

### ULNAR PARALYSIS

In an ulnar paralysis the most obvious indications are atrophy of the interossei muscles, anterior and posterior, the posterior showing more marked waste on account of the absence of well-developed fascia. If the lesion is above the internal epicondyle of the humerus, or if it is a complication of a brachial plexus injury, and the flexor profundus digitorum and the flexor carpi ulnaris are not functioning, then the ulnar "griffe" is pronounced. The hand has a claw-like appearance, and there is a hyperextension of the first phalanges and

an exaggerated flexion of the second and third phalangeal joints, especially of the ring and little fingers. This is a typical deformity of an ulnar paralysis. The "griffe hand" is less pronounced in a high ulnar lesion, although the wasting of the interossei and the three muscles on the hypothenar eminence are much the same as in a low lesion. There is liable to be more flexion

Fig. 35.—Ulnar paralysis, showing atrophy of interossei and muscles of the hypothenar eminence.

deformity of the ring and little fingers in a low lesion because of the muscular pull on the ulnar side of the hand.

The treatment for ulnar paralysis consists of massage for the arm, forearm, and hand. There should be special kneading of the muscles on the ulnar side of the forearm and particular attention should be paid to the interossei muscles. Passive and assistive movements

are given to all the phalangeal and the metacarpophalangeal joints. Every effort should be directed toward overcoming the "griffe" deformity. The interrupted galvanic current is applied preceding manipulation and is replaced by the sinusoidal current or the Bristow coil when evidence of nerve reaction begins to show.

### MEDIAN PARALYSIS

The muscles affected in a median paralysis are the pronator quadratus, the pronator teres, the flexor carpi

Fig. 36.—Median and ulnar lesion, showing atrophy of thenar and hypothenar eminence, also scar following operation of nerve suture.

radialis, half the flexor profundus, the flexor sublimis digitorum, and all the muscles of the thenar eminence except adductors and the deep head of flexor brevis, and the first two lumbricales. The other intrinsic muscles of the hand are supplied by the ulnar nerve.

If there is a complete paralysis above the epitrochlear muscles the position of the hand at rest is not char-

acterized by any special deformity such as is found in the "ulnar griffe" of an ulnar paralysis, or in the "drop-wrist" of a musculospiral paralysis. The loss of certain movements in the hand is the chief means of diagnosis. Pronation of the forearm is impossible except for a slight action of the biceps muscle. Flexion of the hand upon the wrist is weak because the flexor ulnaris is the only muscle performing the movement. Flexion of the thumb, of the index-, and sometimes of the middle finger is impossible except at the metacarpophalangeal joint. This movement is performed by the action of the interossei muscles. Paralysis below the epitrochlear muscles shows very close similarity to the paralysis above the epitrochlear muscles. With the exception of the flexor profundus and the pronator teres, the same muscles are paralyzed.

The sensory areas of a median paralysis usually have marked anesthesia on the radial side of the palm; on the palmar surface of the thumb, index-, and middle fingers; on the dorsal surfaces of the second and third phalanges of the index- and middle fingers; and very often on the external surface of the ring finger. The extent of these areas varies in each case, but the index-finger always shows the greatest degree of disturbance.

A common test in median paralysis is to have the patient oppose his thumb to the cushion of the little finger. This he can rarely do, but by means of the adductors and deep flexors of the thumb, which are not

supplied by the median nerve, the patient may slide the thumb across the palm and touch the flexed little finger on the inside. This is a case of pseudo-opposition, and should not mislead the operator.

The treatment for median paralysis should consist of massage of the entire arm with special kneading of all the flexor muscles. Passive and assistive exercises should aim toward obtaining flexion of the thumb, index-, and second fingers. The patient should be encouraged to try to actively approximate the thumb and little finger. Two useful tests for determining restoration of function in a median paralysis are: first, to have the patient attempt to pick up a pin, and second, to hold the thumb and index-finger in firm approximation against outside resistance. These tests are useful as an exercise. As in the former types of peripheral paralysis, the application of interrupted galvanism to the affected muscles should precede the application of the sinusoidal current or the Bristow coil, until there is some reaction of the affected muscles to the negative pole of the constant current.

### SCIATIC PARALYSIS

In a high sciatic nerve lesion, in which there is a complete interruption of the nerve, all the muscles of the thigh that receive any supply from the sciatic nerve, as well as all the muscles supplied by its branches, are affected. In some instances complete paralysis is present in the entire distribution of both main branches.

If the interruption is not complete, there may be paralysis of either the external popliteal or of the internal popliteal nerve, with a mere weakening of the other.

Whether operation and nerve suture is resorted to or not, a high lesion will necessitate a longer regenerative period than a low lesion, because, in the case of the former, the axis-cylinder has a longer distance to grow. Regeneration takes place from the point of sequence nearest the center, and progresses toward the terminal branches of the nerve-fibers. In a sciatic paralysis the internal popliteal nerve usually regenerates first, which means that the deep muscles supplied by the posterior tibial branch of the internal popliteal nerve—for example, the soleus and the gastrocnemius muscles—are the first muscles to show signs of a return of function. The muscles supplied by the anterior tibial branch of the external popliteal nerve are usually the next to regain function, the peronei group first, and next the dorsiflexors of the ankle. Among the last to return is the tibialis posticus, which is supplied by the posterior tibial nerve. A test for determining whether there is a paralysis of the internal popliteal nerve is to ask the patient to rise on the toes. This cannot be done if the posterior tibial nerve is not intact, because the gastrocnemius muscle will not be able to do its part in the exercise.

Massage and muscle training are the best means of treatment both in the preoperative and the postopera-

tive cases. In all instances assistive movements to the joints should be given in the side-lying position whenever it is practical, in order to eliminate the pull of gravity. If there is no trace of nerve impulse, interrupted galvanism, in which the negative electrode is used over the motor point in the muscle supplied by the affected nerve, and the positive electrode is placed upon another part of the muscle or else over the spinal plexus, has been successfully used in many of the Physiotherapeutical Departments of the United States Army hospitals. As soon as nerve response is found in the muscle, then the slow sinusoidal current or the faradic current of the Bristow coil is substituted for interrupted galvanism.

**External Popliteal Paralysis.**—This is the most common form of paralysis of the lower extermity. A gunshot wound in the vicinity of the knee-joint and over the head of the fibula is very often the cause of injury to the external popliteal nerve or its branch, the anterior tibial nerve. The muscles supplied by this nerve become powerless and allow the foot to drop. The so-called "drop-foot" is a typical deformity of the external popliteal paralysis. A foot appliance is worn not only during the regeneration period, but usually until the anterior tibial muscles are strong enough to maintain the foot in full dorsiflexion. The foot should be supported in dorsiflexion during treatment. A soft roll placed against the sole of the foot will act as a support.

Treatment should consist of massage of the foot, leg, and thigh, with special finger-and-thumb kneading of the anterior tibial and peronei muscle groups. Inversion, eversion, and dorsiflexion exercises should be passive until sufficient muscle response appears to make assistive movements the principal form of exercise. The daily application of from 5 to 10 milliamperes of interrupted galvanic current is useful in combination with the above treatment. From six to eight muscle contractions are given to the tibialis anticus, the extensor longus digitorum, and to the peronei muscles. When nerve response is evident the galvanic current is substituted by the slow sinusoidal current or by the faradic current of the Bristow coil.

**Internal Popliteal Paralysis.**—This form of paralysis is not so frequently found as the former. The principal muscles involved are the ones that comprise the gastrocnemius group and the plantar muscles of the foot. These muscles are supplied by the posterior tibial branch of the internal popliteal nerve. Massage, assistive exercises, and the application of interrupted galvanism, substituted by the slow sinusoidal current if some nerve response has returned, is the best form of treatment.

## FACIAL PARALYSIS

Facial paralysis may be caused either by disease of the seventh cranial nerve, an injury to the nerve trunk, or by a lesion of the brain. If the paralysis is the result

of disease, the cause may be found in the narrow canal in the temporal bone, where the pathologic conditions either from disease of the ear, from hemorrhage, or from other causes may be exerting some pressure on the nerve. In many of the returning soldiers facial paralysis

Fig. 37.—Left facial paralysis, showing relaxed muscles on left side of face owing to injury of the seventh cranial nerve, resulting in a facial paralysis.

was the result of some direct injury at the base of the skull and over the area of distribution of the facial nerve. When this nerve is affected the muscles of facial expression are involved. The angle of the mouth on the relaxed side is depressed and the lips are pulled

toward the side of the face in which the muscles are contracted.

The treatment should consist of stroking on both sides of the face from the midline of the face toward the ear, following the course of the facial veins which empty into the internal jugular vein below the lobe of the ear. The relaxed muscles on the affected side should be picked up between finger and thumb and thoroughly kneaded. Transverse light hacking will help mechanically to contract the relaxed muscle-fibers on the affected side. Finger vibration over the most superficial areas where the branches of the facial nerve divide helps to stimulate the nerve. It is well when the relaxed muscles begin to contract to require the patient actively to practice closing the eyelids and moving the lips on the affected side.

## CHAPTER X

### THE TREATMENT BY EARLY MASSAGE IN CASES OF RECENT INJURY: STRAINS, SPRAINS, DISLOCATIONS

ABOUT thirty years ago Lucas-Championnière published his book entitled, "Traitement des Fractures par le Massage et la Mobilization." His teaching was founded on the axiom of Aristotle, "Movement is life." This book was not primarily written to extol the use of massage, but to advocate the reduction of immobilization to the minimum. Sir William Bennett, in his "Massage in Recent Fractures," states that Championnière uses massage as a means of preparing the way for a dose of mobilization. In his article in *The Lancet*, published in London, in 1898, Sir William introduces this method, and, although meeting with a great amount of opposition from his medical contemporaries, he practised these same methods in his clinical work at St. George's Hospital, London, and taught them to his students. The wonderful technic of massage used and taught by Championnière has not only made for itself a reputation in France and the British Isles, but it has earned universal recognition.

#### STRAIN

A strain is a rupture or overstretching of muscles or tendons. Rider's "sprain," so called, comes under this

heading. There is usually swelling and tenderness about the injured area. If the muscle is ruptured the torn ends are approximated by the application of a bandage or by strapping. This dressing should be done by the surgeon. Rupture may be so complete that operative measures are necessary. Not until the swelling has subsided should gentle passive and active movements, accompanied by mild stroking, be administered to the proximal and distal joints. In a case of severe strain all movements to the joint controlled by the affected muscles should be avoided. Such movements should be postponed until all fear of damaging the repair tissue is passed.

There is a condition between a strain and a sprain that is a semichronic irritation of muscles. This usually occurs near the insertion of the muscles. Lawn-tennis arm is an example of this condition, the irritation in this case being usually at the insertion of the pronator radii teres. Writer's sprain belongs in the same class. In the chronic stage ossification of tendons is liable to take place.

## SPRAIN

"A sprain is a sudden wrenching or twisting of a joint, a sudden partial displacement of two articulating surfaces, followed by immediate replacement. The symptoms are pain, swelling, heat, discoloration, and usually impaired motion." This is Dr. Douglas Graham's definition of a sprain, and it would be diffi-

cult to give a better. In order to treat a sprain intelligently the mechanism of the joint, as well as the art of bandaging, should be thoroughly understood by the operator. In a simple sprain the ligaments are stretched but not torn, and the synovial fluid exudes into the surrounding tissues. Effleurage will help to dispose of the excess of synovial fluid and prevent the formation of adhesions. If there is a complicated sprain, with torn and lacerated ligaments, tendons, muscles, and even nerves, great care is necessary in administering treatment. Much extravasated blood and lymph is dispersed throughout the tissues; this becomes clotted and in organized form constitutes scar tissue, which, if not disposed of, will bind together ligaments, muscles, and even bones. Hot packs until the pain is relieved, with early effleurage that soothes the nervous system through reflex action of the sensory and vasomotor nerves, will prove of great value. The part injured should be kept immobile until repair has taken place. Bandages should be carefully removed, and the injured part should be placed in a position as easy as possible, and slightly elevated to aid the venous flow. Effleurage and gentle friction will help to dispose of the effused products of inflammation. After the effused products have been absorbed, and the pain has been relieved, the massage may be firmer. Early passive movements to the distal and the proximal joints will help to prevent the tendon sheaths from becoming ad-

herent. Flexion and extension movements should suffice until more complicated movements are warranted. In a sprain of the ankle-joint care should be taken to discover which side of the ankle is overstretched, in order that movement in that direction may be avoided, as this would only further rupture the already lacerated parts.

Sir Robert Jones treats an inward sprain of the ankle involving injury about the external malleolus in the following manner: The torn ends of the ruptured ligament (most likely one of the three slips of the external lateral ligaments) are placed in such a position that they can be united. To do this the foot is everted in order to bring the torn ends of the ligament together. Several layers of absorbent cotton are placed around the joint and bandaged in such a manner that eversion is maintained. The bandage is brought from without inward and firmly wound over the absorbent cotton. A rectangular foot splint is applied to avoid any strain on the already overstretched ligament. A large, comfortable boot is worn over this splint bandage. Two wedge-shaped patches of leather are placed on the outer side of the heel to assure continued eversion. All strain now being removed from the external lateral ligament, the patient is advised to walk, and the natural exercise of the foot in walking acts as a continuous massage.

## DISLOCATIONS

A dislocation is a displacement of two articulating surfaces which requires external manipulation for replacement. If a dislocation is complete, the joint capsule is torn. Muscular spasm is by far the greatest difficulty that confronts the surgeon in the reduction of such cases. This is easily seen if an anesthetic is administered. Muscular spasm vanishes as soon as the pain is relieved. Effleurage has been known to act almost in a miraculous way in alleviating muscular spasm. Following the relief of spasm, reduction at times has been accomplished even without the aid of an anesthetic. If the dislocation is not reduced within a few weeks physiologic shortening of the muscles takes place. Reduction under these circumstances is almost impossible. The retention of the articulating surfaces after reduction depends largely upon the healthy condition of the muscles. Therefore, the prevention of muscle atrophy should be the first object in view. Nature will take care of the healing of the joint capsule. The muscles, supplied by the same nerve as the joint, are more liable to waste. If the muscles waste, then the joint becomes lax.

The shoulder-joint is more apt to become dislocated than any other, owing to the looseness of the joint capsule and the shallowness of the glenoid cavity. During treatment the forearm should be supported on a pillow. Massage of the anterior and posterior muscles

of the neck is given with one hand, while the other steadies the shoulder by supporting over the acromion process. The pectorals and posterior scapula muscles and the latissimus dorsi are then effleuraged. On the third day of treatment the gentlest form of passive flexion and extension movements to the shoulder-joint may be given. About the end of the first week all the muscles in the vicinity of the injury may be gently effleuraged. Kneading and mild circumductory movements of the shoulder-joint are next added. In about ten or twelve days after the injury the vigor and length of time of massage is increased. At this time passive movements followed by active movements are prescribed in the following order: flexion, extension, rotation, circumduction, abduction, and adduction. Any overhead movements should not be attempted for at least fourteen days after injury, and should then be performed with great care for fear of the occurrence of redislocation.

Similar treatment to that described above, starting with effleurage and following in a few days' time by pétrissage to the proximal muscles, gradually approaching nearer the seat of injury, is indicated in a dislocation of any joint. Passive movements to the affected joint should be administered with great care, and daily increased range of motion should gradually be sought.

## CHAPTER XI

### THE TREATMENT BY EARLY MASSAGE IN CASES OF RECENT INJURY (Continued)

### FRACTURES

A FRACTURE is a rupture in the continuity of the bone involving all the tissues in its vicinity. If the fracture occurs near the joint, there is liable to be further complication of ligaments, tendons, and synovial membrane, and even damage of the articulating surfaces.

(1) Simple fracture, in which the bone is broken, but not the skin.

(2) Compound fracture, in which the bone is broken, and the skin also, the bone being forced through the skin or an open wound being produced.

(3) Comminuted fracture, in which one or both ends of the bone are splintered.

(4) Multiple fracture, in which the bone is broken in more than one place.

(5) Greenstick fracture, found in children, in which the bone is splintered in part of its thickness, and bent.

(6) Epiphyseal fracture, found in young people before the union of the epiphyses takes place. In this fracture the epiphysis at one end or the other of the bone is separated or displaced.

## PATHOLOGY OF FRACTURES

In a fracture, muscles, tendons, blood-vessels, and sometimes even nerves are torn. If the extravasated blood is allowed to become organized it is liable to bind the soft tissues together or to the bone, and nerve involvement sometimes occurs. Almost immediately after the rupture of a bone a blood-clot forms, and this coalesces with the lime-salt deposit from the bone, producing a callus. There are two kinds of callus—ring or periosteal, which is external to the bone; and pin or myelogenic, which is in the medullary cavity of the shaft. Frequently there is an excess of callus, which in time becomes absorbed, a year or even more being sometimes required.

The main problem in the treatment of fractures is the correct union of the fragments. "Union, however, must not overshadow function." Every effort should be made for the early restoration of function. There is no branch of surgery in which massage and exercise can be used to greater advantage than here. "Muscle is master of bone." The early use of intelligent massage and exercise should not be overlooked if the best results are to be obtained. Dr. Cotton, of Boston, says, "The important thing to remember is that bad results, so far as function goes, are more apt to be the result of bad treatment than a result of the injury." Training and experience alone will not suffice in the care of recent fractures. These must be combined with skill, which

alone can produce that confidence and delicacy of touch that are prerequisites to any genuine success in this kind of work.

In the care of recent fractures length of treatment, pressure exerted, and range of motion in the joints should all increase very gradually. All treatments should last but a few minutes the first day, and should gradually increase to ten or twenty minutes, according to the part being treated.

### UPPER EXTREMITY

*Colles' Fracture.*—This is a transverse fracture of the lower end of the radius with the complication of a sprain of the carpal bones. Frequently the external lateral ligament of the wrist-joint is ruptured, and a small piece of the periosteum is torn from the styloid process of the ulna. In a typical case, the hand is displaced backward and outward. The "silver-spoon deformity" is not at all uncommon following a Colles' fracture. Immediately after the injury the lightest form of stroking will help to relieve early muscular spasm and cause a beneficial reflex of the vasomotor mechanism. Any stroking at this time, however, should be performed by the surgeon in charge of the case. Within a week after the fracture has been set, while the forearm rests on the anterior part of the cast, the posterior part may be carefully removed in order that effleurage of the forearm be given. Gentle voluntary movements of the

phalangeal joints are encouraged from the beginning of the treatment. Mild passive movements to the fingers may be started at the second or third treatment. In the second week the anterior part of the cast may

Fig. 38.—Typical Colles' fracture, showing impacted fracture of lower end of radius and chip off the styloid process of ulna.

also be removed during treatment. The wrist is grasped firmly above the joint and over the seat of the fracture, while gentle passive flexion and extension movements are given to the wrist-joint, after which the two parts of the cast are carefully replaced. In all cases in which

there is fracture of both bones of the forearm pronation of the arm should precede flexion of the elbow-joint.

*Fracture of the Olecranon.*—In a fracture of the olecranon, in which a small fragment is broken from the ulna, if the insertion of the triceps is not torn, gentle

Fig. 39.—Colles' fracture. Lateral view.

massage may be commenced within a week of the injury. The forearm is usually placed in full or almost full flexion. Treatment may be given in that position with the arm resting on a pillow. In kneading the muscles of the arm great care should be taken not to

displace the upper fragment of the bone into the triceps. The same precaution is necessary as for a transverse fracture of the patella. The index-finger of the inactive hand should aim to protect the fragment, while the other hand performs the kneading. After manipulation,

Fig. 40.—Fracture of the olecranon.

passive movements to the shoulder, wrist-joint, and fingers are given. Slight pronation and supination are permitted, but not until the fracture is united. Gentle flexion and extension of the elbow-joint completes the treatment.

*Fracture of the Humerus.*—A fracture of the humerus is spoken of as being in the upper, middle, or lower third. A fracture in the upper third frequently involves

Fig. 41.—Fracture of the middle of humerus.

impaction of the head and neck of the humerus. An impacted fracture is bandaged to the body, using the body as a splint. About the fourth day the bandage is

very carefully removed, in order to give gentle stroking and light kneading to the muscles surrounding the shoulder-joint.

Fig. 42.—Fracture of the upper third of the humerus, including the head, with downward subluxation as a result of the relaxation of the deltoid muscle.

It is most convenient in giving the treatment to have the patient seated with the forearm of the affected limb supported in a sling and resting upon a pillow. Gentle circular kneading over the region of the chest and the

posterior surface of the scapula is used for only a few minutes for the first few treatments. The object of the treatment is to aid the absorption of the hematoma. After several treatments the hands of the operator may gradually approach nearer the seat of the injury. At this stage of the treatment passive exercises, with movements of the fingers, are introduced. The fixation apparatus should be in position for all movements to the joints, and the forearm should be supported. About the end of the second week passive movements of the wrist- and elbow-joints are started. Movement of the shoulder-joint requires great care, and only slight forward and backward movements are given in the antero-posterior plane of the body. The operator, using the fingers and thumb of one hand, keeps steady the region of the tuberosities, while the other hand performs the movement. Abduction and rotation are not employed until late in the convalescing period. The above outline of treatment holds good for fractures of either the upper or middle third of the humerus. At first all movements should be given with the muscles of the patient relaxed as much as possible. Later the patient is encouraged to participate in the movements and thus make them assistive. Any sign of muscle spasm in the shoulder muscles is of significance. Should this appear, the operator's arc of motion must be narrow enough to avoid the muscle spasm.

Union of fracture of the middle of the shaft of the

humerus usually requires a little longer time. In a fracture of the lower third the elbow-joint is sometimes involved. Usually an excess of callus is found in fractures near the elbow-joint, except in those of the olecranon. Gentle kneading of the muscles of the arm and forearm is given, the forearm being supported, and passive movements to the fingers, wrist, and shoulder follow in succession. Movements to the elbow-joint should be avoided until union is established. Dr. James B. Mennell claims that "mobilization tends to counteract the inhibitory action of the synovial fluid." It is recognized that synovial fluid inhibits the formation of the callus. Mennell advocates the free administration of movements in fractures of the humerus near the elbow-joint in order to counteract the inhibitory action of the synovial membrane.

*Fracture of the Clavicle.*—For treatment of a fracture of the clavicle the patient may be seated, unless there is fear of displacing the fragments of the bone, in which case the patient should be lying down with the head low. The elbow is supported by the side, the hand resting on the body. A pillow is placed under the limb, and the muscles of the neck and chest receive manipulation before the muscles of the arm. Passive movements are given to the fingers, wrist, and elbow-joint. It is better to postpone movements to the shoulder-joint until at least fourteen days after the injury. The greatest caution is necessary when giving these movements.

## LOWER EXTREMITY

*Pott's Fracture.*—A Pott's fracture is a fracture of the lower end of the fibula including a rupture of the deltoid ligament and an outward dislocation of the foot. If both bones of the leg are fractured the break in the

Fig. 43.—Fracture of the fibula (anterior posterior aspect).

fibula is often at a higher level than that in the tibia. The treatment is much the same in either case, except that, if the tibia also is involved, much more precaution must be taken in the removal and replacement of the splints and in the administration of the treatment. A box splint with a vertical foot-piece not only makes

a safe encasement, but it also acts as a protection against the "foot-drop" position. If the foot is allowed to drop, the lack of tension on the large superficial veins in the calf may result in a thrombus in the vein. A common

Fig. 44.—Fracture of the fibula (lateral aspect).

pain in fracture of the leg is that which shoots downward from the seat of the fracture, along the back of the leg, behind the internal malleolus, and into the sole of the foot. The pain is the result of a neuritis produced by

adhesions at the level of the injury, and is often very acute. This sometimes involves the posterior tibial nerve and gives rise to a neuralgic pain.

Treatment should be started about the end of the first week, the whole limb being well supported on a plint. Treatment should consist of effleurage of the foot and leg, followed by passive movements to the toes. Movements to the ankle-joint are postponed until at leat twelve days after the injury. In the case of a Pott's fracture care should be taken to avoid further damage to the already ruptured deltoid ligament by any outward motion of the ankle. About the twelfth day the ankle is firmly grasped over the seat of the fracture by one hand of the operator, while the other hand carries out the movements of flexion and extension to the ankle-joint. Abduction and adduction, inversion and eversion follow at a later date. The patient is encouraged actively to move the toes from the start, in order to keep the flexor and extensor tendons from becoming adherent.

*Fracture of the Patella.*—If the patella is ruptured transversely, and if kangaroo tendon suture is not used, great care is necessary in order to prevent separation of the fragments. The first treatment consists of effleurage of the quadriceps group. While one hand administers the stroking, the forefinger and the thumb of the other hand support the patella above and below, in order that the fragments may be kept together.

Gentle kneading of the quadriceps, the adductors, and the hamstrings should follow effleurage about the third treatment. Separation of the fragments must be guarded against throughout all the treatments. When union of the bone is assured, exercises to the knee-joint may be started.

Fig. 45.—Fracture of patella (transverse).

Resistive exercises are of more value than passive when greater range of motion in the knee-joint is the object sought. If passive movements are given after an injury near the insertion of the quadriceps, muscle spasm would occur and limit motion in the joint. The

manner of giving positive and negative resistance movements is as follows: After the removal of the cast the patient should lie with the affected leg over the end of the plint. The heel is supported by the operator, who offers graded resistance while the patient voluntarily contracts the hamstring muscles. Along with this action there is a relaxation of the quadriceps. Extension of the leg is next given by the operator, the patient at the same time offering resistance. This requires further contraction of the hamstring muscles, thus relieving any tension of the quadriceps group.

*Fracture of the Femur.*—A fracture of the femur may be either inside or outside the joint capsule, with an impaction of the neck of the femur. In elderly people this is not an uncommon form of fracture. If union is despaired of, and immobilization is considered impracticable on account of the age of the patient, then light stroking and only a small amount of gentle kneading is indicated. Because in elderly people the reflex arc is easily tired, it is important that certain muscle groups be relaxed in order that passive movements may be given to the joints. Exercises should be preceded by stroking of the entire limb from the toes to the hip-joint. If the muscles are painful and rigid this stroking has a wonderfully sedative effect. The hand of the operator is next slipped under the knee-joint, and the patient is encouraged voluntarily to contract his own muscles, so that a pillow may be placed under the knee.

In order to flex the hip-joint the operator grasps the heel with one hand, while with the other hand he makes a support under the knee. Care is necessary to keep the foot from turning inward, as this is liable to cause the patient pain. For re-education of the limb it is

Fig. 46.—Fracture of head of femur (intracapsular). (F. J. Cotton.)

best to have the patient stand on the sound limb while the affected one is actively swung backward and forward several times. The placing of a little weight on the limb is next encouraged, and with each step the weight is gradually increased.

If there is a fracture of the femur without impaction, the treatment is much the same as that described for a fracture with impaction, except that the massage

Fig. 47.—Fracture of the head of the femur, showing impaction of the neck (extracapsular). (F. J. Cotton.)

is heavier and must be postponed until the splintage and extension applicances can be removed.

Spontaneous fracture sometimes occurs in elderly people on account of the bone being brittle and the muscles being soft. The treatment is the same as for

the conditions just described, and depends entirely upon whether the limb was put in a cast or not.

In the treatment of ununited fractures in which there is merely fibrous union great care should be taken to use no forcible stretching that might tend to damage the work of repair already accomplished.

In ununited fractures in which union is questionable the application of heat in the form of diathermy has proved to be of great value. From 400 to 600 milliamperes of the D'Arsonval type of high-frequency current used daily for about twenty to thirty minutes preceding manipulation of the muscles not over but near the seat of injury will aid in the development of new osteoblasts. In this way the formation of healthy callus is stimulated.

# PART II

# THERAPEUTIC EXERCISE

## CHAPTER I

### HISTORY AND DEVELOPMENT OF THERAPEUTIC EXERCISE

THERAPEUTIC exercise is by no means a new form of therapy. Both exercise and rubbing were used extensively in the time of Hippocrates, 460 B. C. Even before this in the far East there was a book written in Chinese about 3000 B. C., called the "Cong-Fu," which dealt with prescribed movements. Hippocrates and his famed teacher, Herodicus, each taught gymnastics for the preservation of health and the cure of disease It is claimed that Herodicus cured himself of physical defects by the application of his own theories and lived to be one hundred years of age.

Galen, a noted and respected Roman physician who lived from 130 to 200 A. D., was greatly interested in friction and prescribed exercise. He, like Herodicus, practised his own theories of regular exercise in order to overcome a general physical weakness. He discovered that the arteries were filled with blood in the living body, and not with air, as the Greeks believed, although

it was not until 1628 that William Harvey discovered the circulation of the blood.

Peter Henry Ling in 1813 established the Royal Gymnastic Central Institute at Stockholm, Sweden. Ling was not the originator of medical gymnastics or massage, but he was one of the pioneers who systematized this kind of work. Although today there are many systems, all are based upon the system of Ling.

About 1770 the Germans founded a school of gymnastics. The German ideas undoubtedly influenced Ling in his later work. He attended a school of German gymnastics in his early days. For many years there has been a good deal of contention among the supporters of the various systems of gymnastics, but perhaps there has been no greater rivalry than that between the advocates of the German and the Swedish schools.

Basedow, about 1774, expounded in Germany his ideas on exercise, his central theme being Rousseau's theory that body and mind assist each other. The German system emphasizes the use of the horizontal and parallel bars and the vaulting apparatus, upon which many of the exercises are performed. These exercises, by the constant use of the arms in supporting the body weight, develop chiefly the muscles of the shoulder-girdle. The German system often controls the rate and rhythm of exercise by an accompaniment of music. Imitation takes the place of command in much of the teaching of German gymnastics. This insures a reserve

of nervous energy, but also obtains the beneficial effects of muscular exercise. These are the principles upon which the German system is based.

The French, represented by the Delsarte school, strongly emphasize the value of muscular action as an expression of the person's thought. Delsarte did not publish any complete or adequate system of his ideas on this subject. His teachings were systematized by his faithful followers. Relaxation is the fundamental principle of the Delsarte system. The Americanized form of the Delsarte method is best known through the writings of Emily Bishop and Anna Payson Call. By the latter emphasis is laid upon the overcoming of chronic nervous tension through relaxation, this being attained by self-suggestion.

Rhythm in exercise, accompanied by thought expression, is the basic principle of eurythmic training. Time, rhythm, and movement are not regarded as an accompaniment to music, but are used as a means of expressing the emotional ideas of the music.

Every system of gymnastics should be based upon a knowledge of the anatomy of the human body and upon the laws which control its functions. Gymnastic training should find expression in perfect control of muscle action.

Although each system has contributed to educational gymnastics, it is to the Swedish school and to Ling and his faithful followers that medical gymnastics owes its

development. Medical gymnastics, Swedish remedial exercises, corrective gymnastics, and therapeutic exercise are synonymous terms.

Ling claimed that gymnastics has a rightful place in education, military training, and in medicine. About one year after the opening of the Royal Gymnastic Central Institute he commenced to develop his medical gymnastics. Although meeting with a great deal of opposition, Ling continued his study of anatomy and physiology in the light of the knowledge of that period, and worked out from these subjects a practical system of gymnastics. Ling's son, Hjalmar Frederick Ling, devoted his life to the study and the perfecting of educational gymnastics. He was the instigator of the grouping of exercises called "The Day's Order," which is the backbone of Swedish educational gymnastics today.

In this formula of exercise the extensor muscles are developed, which during ordinary vocations are given a minimum amount of use. In the neck, these are the sternomastoid, splenius capitus, rectus capitus posticus (major and minor); in the arm, the triceps, the posterior fibers of the deltoid, the infraspinatus, the teres major, and the latissimus dorsi; in the scapula, the upper fibers of the trapezius, the levator scapulæ, and the rhomboidei muscles.

Accuracy, clearness, precision, progression—these are the principles which stand out in the Swedish system. Throughout Swedish gymnastics there is a marked

military note. Ling systematized medical gymnastics, classifying them, in general, into two big divisions—massage and exercise. Movements done *upon* the body belong to the first of the two divisions; movements done *with* a part of the body belong to the second division.

Branting was appointed successor to Ling as president of the Central Institute. Having been a student in one of the largest medical schools in Sweden, he devoted his life to the study of medical gymnastics. Branting followed very closely the theories of his predecessor and claimed that exercises were not only beneficial to the muscular system, but that they also exerted a favorable influence upon the nervous and vascular systems. Much of Branting's terminology is still used. Hartelius was a graduate of one of the finest medical schools in Sweden and succeeded Branting as president of the Central Institute. The course of instruction in the Royal Gymnastic Central Institute was extended from one to two years. The completion of a three years' course is now necessary before a diploma is granted. A course of one year's duration is offered to medical men. Dr. Robert Murray, of Edinburgh, succeeded Dr. Hartelius.

## CHAPTER II

### PHYSIOLOGIC OBJECTS GAINED BY EXERCISE

EXERCISE has definite physiologic effects upon the structures of the body and upon its functions. The muscular, circulatory, respiratory, nervous, and digestive systems are directly influenced by exercise, whether it be of a passive or active kind. Passive exercises conserve nervous energy and may be used to great advantage if nervous energy is much under normal. Active exercises are of especial benefit to the muscular system, and may be used if they do not lay too great a tax upon the vitality of the patient. In order to obtain the best results from exercise a period of rest should follow any strenuous activity. A standing posture of rest should be in the least harmful position. Relaxation should not be continually on one side, because of prolonged strain upon the ligaments on that side of the body, which results in bad posture. The patient is instructed to change the rest position from one side to the other.

In the muscular and bony systems hypertrophy follows a period of continuous use, and atrophy follows a period of continuous disuse. Increase in the size of muscle means increase in strength. Moderately strong muscles are necessary for the maintenance of health,

vigor, and vitality. Muscles are the executive organs that perform definite physical work. The development of muscles should be to the degree necessary to perform their work with ease. The overdevelopment of muscles is injurious. An increased amount of nourishment is necessary for each additional muscle-fiber. The organs concerned with nutrition adapt themselves to the increased demand. Endurance and vigor are at their maximum if the nutritive demand of the skeletal muscles is no greater than the power to furnish this nutrition. In a well-nourished muscular system much work may be accomplished without causing overfatigue. Poorly developed muscles are found in persons who lead a sedentary life and who do not get plenty of outdoor exercise. The farmer or the outdoor laborer usually acquires sound, healthy musculature. Metabolism is increased by exercise and deep breathing; consequently, there is more and better oxygenated blood to nourish the cells and increase the size of the fibers in the active muscles.

In a person with a well-developed muscular system the bony structure is also better developed. Ridges on bones, which mark muscle attachments, show signs of developed or undeveloped muscles. In conditions in which atrophy from disuse of muscles is pronounced the *x*-ray will show an accompanying atrophy of bone.

In the circulatory system an active muscle forces the blood through the veins in the direction of the heart

during contraction. The veins and arteries are emptied during the contraction of the muscle, and upon relaxation are refilled. These suction and pressure processes are much increased by exercise. The expansion of the arterioles following exercise may be caused by increased metabolism in the active muscles or by a reflex stimulus of the vasodilator nerves. Hasebroek, in his experiments, has proved that resistive exercises have caused a reduction in the blood-pressure notwithstanding an initial rise immediately after exercise. Although experiments by other men have seemed to contradict this conclusion, there are other conditions in the circulatory system which might account for this difference of opinion. When dilatation of the peripheral vessels takes place, an influx of blood from the abdominal and portal veins follows in consequence, so that even more blood will flow into the aorta from the left ventricle.

In the nervous system neuromuscular training incorporates co-ordination of muscle and nerve. The trained gymnast is able to conserve nervous energy, which an untrained person is unable to do. Nerve centers in the brain can be trained to control finely co-ordinated muscle actions, but this requires regular, systematic work. The sensory nerves, by this training, are cultivated to the highest degree of apperception. Because of increased metabolism in the active muscles during exercise there is improved nutrition in the motor and sensory nerves. The walls of the blood-vessels and

the involuntary muscles of the viscera are controlled by the vasomotor nerves of the autonomic system, and therefore the functions of the blood-vessels and of the viscera are improved by increased nutrition to the nerves.

In the respiratory system the beneficial results of systematic, regular exercise upon the respiratory system are very pronounced. Breathing exercises develop the functions of the throat, larynx, and trachea. Chest expansion promotes the development of the respiratory muscles, and is noticeable to a marked degree in persons who are undergoing vocal training, because breathing plays such an important part in this study. The compression exerted in the thorax during deep inspiration and expiration increases the venous and lymphatic flow to the heart. The heart is therefore assisted in its action through the compression caused by deep breathing. The increased activity that accompanies games and sports is beneficial for its physiologic effects. The accessory muscles of respiration are brought into play and deeper respiration becomes necessary. More air is taken into the lungs and more blood is exposed to the air in the capillaries of the lungs, making possible a greater interchange of gases. In this way poorly developed lungs are able to cope with the demand of the body. Frequently tuberculosis develops in persons who neglect this thorough aëration of the lungs, for the upper lobes are a harbor for the tubercular bacilli. If a

patient in whom tubercular tendencies exist is taking breathing exercises, he should be taught forcibly to raise the sternum, for this allows a more thorough aëration of the upper extremities of the chest cavity. The pressure exerted in the thorax by increased respiration is especially beneficial in its suction effect upon the venæ cavæ and the thoracic duct.

In the digestive system the action of the diaphragm is such that during inspiration the diaphragm contracts, and internal pressure is thus exerted upon the abdominal viscera. There should be a continual balance between the systemic and portal systems. If owing to enforced rest or to intestinal trouble congestion of the portal circulation exists, this balance is disturbed. Exercises for the abdominal muscles, along with systematic diaphragmic breathing, will help to relieve the internal congestion and re-establish the balance. The pressure and relaxation brought about by increased respiration also acts as internal massage upon the liver, stomach, and the rest of the abdominal viscera.

## SUMMARY

Systematized exercise exerts a favorable physiologic influence upon metabolism through the physical and chemical changes which are brought about by regular contraction of the various groups of active muscles, thus causing general improvement in the environment of all the cells in the body. It promotes vascular contraction,

which has a stimulating reactionary effect upon the internal organs because of an increased demand for blood. It improves the balance between the accelerator and the inhibitory nerves of the heart, and this has a favorable influence upon the strength of the heart muscle itself. It necessitates a more thorough ventilation of the lungs because respiration has been increased. It improves digestion because the digestive secretions are promoted and absorption is encouraged.

## CHAPTER III

### FUNDAMENTAL AND DERIVED GYMNASTIC POSITIONS; A DAY'S ORDER

EDUCATIONAL gymnastics is adapted to the approximately normal individual, and therapeutic gymnastics is adapted to the abnormal. The student who is expecting to use therapeutic gymnastics to the best advantage should have some knowledge of the principles which are the basis of educational gymnastics. The nomenclature of the Swedish system is reduced to a minimum in this book in order that the student who is not acquainted with that system may be able more easily to use the tabulated exercises. Preventive exercise, in which the incipient form of some pathologic condition may be dealt with, is the most satisfactory kind of therapeutic work. Although each patient requires individual study and attention, there are times in which it is not only possible but of great value to group the different types of cases. As certain types of spinal weaknesses may be divided into groups for special exercises, so classes may be formed of patients suffering from general debility, foot weaknesses, convalescing empyema, spastic paralysis, and cardiovascular disturbances. Before describing the fundamental and derived posi-

tions, some rudimentary definitions of gymnastics and certain directions relative to conducting classes may well be given.

A *movement* is a change of place, position, or posture.

An *activity* means the opposite of rest.

A *posture* is a position assumed by the body, from which certain movements are performed.

A command in gymnastics is divided into three parts: (1) The explanation, in which the activity is clearly and briefly defined; (2) a pause, sufficiently long for the explanation to be understood; (3) the command itself. This command should have force or intensity except when used for exercises whose object is relaxation; as, for example, cardiovascular exercises, in which the command itself should be given slowly following the rhythm of breathing. All commands should be given in a well-modulated voice and in clear tones.

There are five fundamental positions in Swedish gymnastics—standing, sitting, kneeling, lying, and hanging.

## FUNDAMENTAL GYMNASTIC POSITIONS

In the *fundamental standing position* in educational gymnastics the heels are held together, the toes forming an angle of not more than 45 to 60 degrees. The knees and hips are fully extended; the head is erect, the chin is drawn in, the chest is well lifted, and the arms hang in contact with the lateral aspect of the thighs. The elbow-, wrist-, and finger-joints are in a position of ex-

tension. In medical gymnastics the same body posture is assumed, but the feet are placed parallel. The funda-

Fig. 48.—Fundamental standing position.

mental standing position is emphasized in every form of gymnastic work.

In the *fundamental sitting position* the patient sits with the whole of the thigh supported. The hip-, knee-, and ankle-joints are kept at right angles, the feet on the floor and the legs slightly apart. The head and trunk are held the same as in the fundamental standing position, the arms hanging by the sides.

In the *fundamental kneeling position* the patient kneels on the floor or on a low plint, with the knees and feet held close together, and the feet plantar-flexed. The

Fig. 49.—Fundamental lying position.

head, arms, and trunk are held the same as in the fundamental standing position.

In the *fundamental lying position* the person lies on the back; the legs are kept close together; and the arms are held close to the sides, so that the whole of the body is supported.

In the *fundamental hanging position* the person grasps a bar, boom, or fixed apparatus; the feet do not touch the ground, and the body is suspended. The hands should be a little more than shoulder width apart and

are pronated while gripping. The arms, legs, and trunk are fully extended, the head is held erect, and may be slightly thrown back. The chest is well lifted.

### DERIVED GYMNASTIC POSITIONS

Positions taken from any of the fundamental positions are called derived positions, and are obtained by moving the head or the arms, by changing the position of the legs, or by changing the position of the trunk. A combination of derived positions denotes a mark of progression.

#### *Some Derived Positions from the Fundamental Standing Position*

I *a*. By moving the head:

*Arch flexion standing.* Head bending backward.

I *b*. By moving the arms:

*Wing or hips firm standing.* The hands are placed on the hips, fingers forward, and thumb backward. The elbows are carried slightly backward.

*Rest or neck firm standing.* The finger-tips of each hand are placed on the nape of the neck and touch each other. The head should be erect and the elbows held well back.

*Bend standing.* (*A*) The arms are placed in the upward bend position; the forearms are placed against the arms, which remain by the side of the trunk. The elbows should be held as close to the sides as possible.

(*B*) The arm is placed in the forward bend position; the forearm is flexed on the arm, which is in a horizontal plane with the shoulders. The wrist should be straight,

Fig. 50.—Two derived positions from the funamental standing position: by moving the arms; by changing the position of the legs.

and the palms turned down. The bend stand position is the initial position for all extension movements.

*Stretch standing.* The arms change from any of the arm bend positions to the vertical overhead position by

one count for bend and one count for stretch overhead, palms facing.

Fig. 51.—Three derived positions from the fundamental standing position: by moving the arms; by changing the positions of the legs; by changing the position of the trunk.

*Reach standing.* The arms are stretched forward on a level with the shoulders, the width of the shoulders between; palms facing.

*Arm flinging.* The arms pass quickly from the bend to the stretch position, beginning the movement with the arm forward bend position.

II. By changing the position of the legs.

*Stride standing.* The feet are moved sideward, about two foot lengths apart, and are parallel in therapeutic exercise. The stride stand position makes a wider base, and is therefore an easier position for the patient than the close standing position if derived trunk movements are being performed.

*Toe standing or heel raising.* The heels are raised from the ground, being kept in contact with each other.

*Knee bend standing.* The knees are flexed and separated. A combination of knee bend with heel raising is commonly used.

*Fall out standing.* The right or left leg is placed three foot lengths forward. The knee is bent until it is directly above the toes. The reverse leg is kept in the fully extended position, and there should be a straight line from the heel to the head. The shoulders should be level and square to the front.

III. By changing the position of the trunk:

*Stoop standing or trunk bending forward.* Flexion of the trunk to an angle of 45 degrees takes place at the hip-joints. The knees are fully extended and the spine is kept straight.

*Lax stoop standing or trunk bending forward downward.* Flexion of the trunk at the hip-joint with the

knees fully extended, the vertebral column bending upon itself and the arms hanging loosely forward.

*Arch or backward bend standing.* The trunk is bent backward, extension chiefly taking place in dorsal region.

*Turn standing.* The body is turned or twisted to one side or the other as far as possible without changing the relative positions of the head and shoulders.

### *Some Derived Positions from the Fundamental Sitting Position*

I. By moving the arms:

*Wing sitting.*

*Neck firm sitting.*

*Stretch sitting.*

*Reach sitting.*

These positions are taken in the same way as from the fundamental standing position.

II. By changing the position of the legs.

*Stride, sitting.* The same position as the fundamental sitting, except that the legs are separated in order that the feet may be two foot lengths apart.

*Ride sitting.* The patient sits astride a plint or stool. High ride sitting is the same position taken from a high plint.

III. By changing the position of the trunk.

*Arch sitting.*

*Stoop sitting.*

*Lax stoop, sitting.*

These positions are taken in a similar manner to those described in the fundamental standing position.

*Fall sitting.* The trunk is inclined backward from the hips. The knees and feet are supported.

*Spring sitting.* One leg is bent forward, the thigh being supported upon a stool. The other leg is stretched backward and rests upon the toes. A straight line from the heel to the head is maintained similar to that in the fall out standing position. The spring sitting position is much used in exercises for scoliosis, along with arm stretchings.

Derived positions from the fundamental kneeling, lying, and hanging positions are formed in same way as in the fundamental standing and sitting positions by moving the arms, by changing the position of the legs, and by changing the position of the trunk. A combination of two or more derived positions may be used; for example:

*Trunk twisting wing stride standing.* The trunk is turned to one side or the other without moving the hips. It is easier to take this position from the stride stand hips firm position.

## A DAY'S ORDER

A day's order means that every muscle in the body is exercised without fatiguing any group at any time. Hjalmar Ling was the instigator of this method of systematizing a progressive schedule of exercises for the various muscle groups of the body. He worked out this

formula from the theories of his father, Peter Henry Ling. This schedule of exercises for various muscle groups is the backbone of Swedish educational gymnastics.

1. Introductory movements.
    1. Order movements.
        Types:
            Marchings, facings.
            Hand placings and foot placings used for keeping attention and getting response from the individual.
    2. Arm movements (given under respiratory).
    3. Leg movements.
        Types:
            A. Those with little physiologic effect:
                1. Facings.
                2. Foot placings.
            B. Those that call into play the larger muscle groups which need to be used to keep the body in good tone:
                1. Heel raising.
                2. Heel raising with knee bending.
            C. Unilateral movements:
                Single knee bending, etc.
    4. Tense bending activities (to increase the size of chest cavity). Reversing as far as possible the character and muscular action of a relaxed posture; always attempting overcorrection.

Types:

A. Back bend of head (work in cervical region).

B. Exaggerated erect posture (especially for the dorsal region, the ribs spreading out "fan-like" in front).

5. Dorsal activities (for shoulder-blade, neck, and upper back muscles).

Types:

A. Standing, trunk bending forward.

B. Exercises in fall out positions, combining arm and foot movements.

C. Transverse prone lying (body across some apparatus).

D. Exercises in the horizontal foot grasp position.

6. Balance activities (equilibrium co-ordination in which the co-ordination is more for brain activity than for muscle).

Types:

A. Free standing:

1. Knee bend and stretch.
2. Knee bend, stretch and bend, with foot placing forward.
3. Leg stretching sideward, circumduction, and foot replace.

B. Balance walking (with or without apparatus).

C. Play, with the balance elements introduced.

7. Heaving activities. (Origin and insertion of muscles are reversed in heave movements.)

Types:

A. In which the weight is suspended from the arms.

B. In which the weight is partially supported by the feet.

C. Movements for abdominal muscles taken from hanging position.

8. Abdominal activities (for the control of the viscera by strengthening the abdominal muscles).

Types:

A. Trunk archings (included in trunk bending).

B. Lying leg raising.

C. Sitting trunk reclining.

D. Lying trunk raising.

E. Prone falling.

9. Lateral trunk activities.

Types:

A. Trunk bending sideward.

B. Trunk twistings.

C. Combination of trunk sideward or forward bend and twist.

10. Precipitant activities. (Effects are increased heart-beats and increased respiration, that is, a general physiologic effect.)

    Types:

    A. Jumping.
    B. Swinging.
    C. Vaulting (hands on apparatus); dancing or hopping.
    D. Running or running games.

11. Respiratory activities.

    Types:

    A. Arm raising.
    B. Hand turning.
    C. Arm circling.
    D. Bend stand arm stretch.
    E. Slow leg activities (to bring the heart-beat back to normal).
    F. Exaggerated stretching posture.
    G. Hands on chest at ninth rib, inhaling, exhaling.

In the Canadian Army hospitals a system of exercises for the following grades of disabilities was devised and used in the physical therapeutic departments:

Group A. Slight disabilities, muscle strength being one-half to three-quarters normal.

Group B. Severe disabilities, muscle strength being one-quarter to one-half normal.

Group C. Complete disabilities, muscle strength being one-eighth to one-quarter normal.

This grouping of disabilities according to diagnosis seems good if, from a practical standpoint, the grade of disability can be determined.

A list of exercises in groups A, B, and C, according to the Canadian schedule, will be found in the Appendix.

# CHAPTER IV

## POSTURE TRAINING; EXERCISES FOR GENERAL DEBILITY; ABDOMINAL EXERCISES

### POSTURE TRAINING

GENERAL debility is likely to be accompanied by a condition known as "poor posture." This is very often caused by an overtired condition of the nervous system, and signifies disordered balance of muscle action. Normal function of the nerves that control the voluntary and the involuntary muscles is lacking. The skeletal muscles, supplied by the cerebrospinal nerves, and the abdominal viscera, supplied by the splanchnic nerves of the autonomic system, are all affected.

All treatment should aim to assist in restoring the nervous system to a normal condition, and to overcome ptosis, which is a sagging of the abdominal viscera frequently known as visceroptosis. The cause of the debilitated condition should be sought and corrected if possible. Rest, out-of-door exercise, and plenty of sleep are necessary, in combination with physical therapeutic treatment. A daily tonic—hydro treatment—is excellent if it is available. A warm needle-and-spray shower, followed by an alternate hot-and-cold douche up and down the spinal column, preceding a general

massage and special exercises, makes an excellent prescription.

Fig. 52.—Good posture. Head erect, chin in, shoulders drawn back and down, abdomen held in, and body weight falling on the balls of the feet.

Posture training should be the first lesson taught. The understanding and co-operation of the patient is

necessary from the start. The feeling of "correct posture" cannot be too strongly emphasized, and an effort should be made to develop the "posture sense" in the mind of the patient. Large double mirrors are used for all posture training positions and exercises. Photographs showing the appearance of the figure at the start of the treatment, and again at a two months' interval, during which time the patient has been doing daily systematic exercises, have been found most helpful. The patient is taught how to stand and sit correctly, and is given special exercises that will help to overcome the existing muscular weaknesses.

In educational work there are four recognized types of bad posture. The first is known as the fatigue position, in the first stage of which the neck and head usually droop forward, and the upper part of the trunk sinks backward. The second stage of this fatigue slump is a compensatory relaxation of the abdominal muscles, accompanied by an exaggerated lumbar curve. The second type is known as the obliterated lumbar curve. The third type is the overextension type, or the bantam position, and is more often found in children. This is the result of a mistaken effort to lift and expand the chest, which throws the region of the stomach and chest too far forward and upward. These three types all indicate some change in the anteroposterior line of the body as a result of some part or parts of the body being carried too far backward or forward. The fourth type

Fig. 53.—Poor posture, showing sunken chest, exaggerated lumbar curve, and body weight falling on the heels.

Fig. 54.—Second type of poor posture, showing the obliterated lumbar curve.

represents a lateral deviation. The defects of this type are that one shoulder is lower than the other; the head is carried to one side, the shoulders are tilted to one

side; and the hips are uneven. This condition is known as scoliosis, and is discussed in Chapter VI, Part II.

The vertical line test is used in order to assist the eye in determining perfect or faulty posture. The long axis of the body as a whole is represented by a vertical line. With the head erect, a line dropped from the lobe of the ear should pass through the center of the round of the shoulder, slightly forward of the center of the hip and in front of the knee. The weight of the body should fall upon the outer border and transverse arch of the foot. This is an illustration of perfect posture, and is what is known in gymnastics as the fundamental standing position. In this position there is full expansion of the chest and contraction of the abdominal muscles. The center of gravity differs in different individuals according to muscular and adipose development. Drs. Lovett and Reynolds have demonstrated that generally the center of gravity in the adult lies in front of the ankle-joints, in front of the knees, and in front of the vertebral column, except possibly in the lumbar region. In poor posture, the axes of the main portions of the body—the head, neck, and trunk—instead of forming one continuous vertical line are broken into two or three zigzag lines. Secondary fatigue posture throws an unnatural strain upon the muscles and ligaments, cramps the heart and lungs in the thoracic cavity, retarding their functions, and causes a sagging of the abdominal viscera.

For poor posture, exercises to strengthen the weakened muscles of the chest, scapulæ, and abdomen are given. If ptosis exists, it is well to use the knee-chest position, following special exercises. The patient assumes a prone lying position for two to ten minutes once or twice daily, with the greatest possible incline of the spine from the hips to the head. The knees and chest should rest on a flat surface. In this way gravity is used to assist the viscera in resuming their normal position.

### EXERCISES FOR GENERAL DEBILITY

The following are a few exercises for general debility given after special posture training and studied corrective positions:

*Fundamental Standing Position:*

1. Head bending backward.
2. Alternate knee bending and stretching (forward).
3. Heel raising, knee bending (with various arm positions).
4. Arms bending upward, stretching sideward.
5. Clapping hands overhead and back of body with feet jumping sideward, and returning to place (in two counts).
6. Hands on hips, trunk bending forward.

*Fundamental Lying Position:*

7. Alternate knee bending.
8. Alternate knee bending upward and stretching.

9. Both knees bending and stretching upward, bending and lowering slowly.

*Fundamental Standing Position:*

10. Hands on hips, stride standing position, trunk twisting (alternate right and left).

Fig. 55.—Patient in position for abdominal massage with abdominal muscles partly contracted.

11. From arm stretching sideward stride standing position, trunk bending sideward (alternate right and left).

12. A. Arm turning.

B. Arm circling.

### ABDOMINAL MASSAGE AND EXERCISES

There are no remedies so efficient as natural ones for constipation. Care of the diet, plenty of active outdoor exercise, regular habits of living, and drinking plenty of water make a simple but effectual prescrip-

Fig. 56.—Trunk raising upward from fundamental lying position, feet held by operator, for strengthening the abdominal muscles.

Fig. 57.—Supine lying position, leg bending upward. First part of movement for strengthening the abdominal muscles.

tion. In cases of long standing abdominal massage accompanied by special exercises are beneficial. Abdom-

inal massage consists of transverse kneading of the colon, followed by circular kneading of the same, firm stroking of the ascending, transverse, and descending colons (special attention being paid to the hepatic, splenic, and sigmoid flexures), liver kneading and beating, and vibration of the abdomen with the cupped hand.

Fig. 58.—Leg lowering slowly. Second part of movement for strengthening the abdominal muscles.

### EXERCISES FOR CONSTIPATION

1. Patient lying, diaphragmic breathing (knee bend position).

2. Patient half-lying, leg circumduction.

3. Patient lying, double leg flexion (well upon trunk), and extension.

4. Patient lying, arms sideward raise, right leg knee bend, hands clasped over knee and pressed against chest.

5. Sitting, hands on hips, trunk circumduction.

6. Sitting, toe support, trunk reclining backward and raising.

7. Standing, hands on hips, heel raising, knee bending.

8. Standing, arm raising sideward, with deep breathing.

9. Patient astride sitting on high plint, hands clasped behind back, trunk circumduction.

10. Lying, trunk raising without use of arms.

11. Stride standing, throwing medicine ball, using the lateral trunk muscles.

Definite physiologic objects gained by abdominal massage and exercises are given below:

1. They stimulate the liver and gall-bladder.

2. Aid digestion in the stomach and intestines.

3. Relieve constipation by increasing peristaltic action.

4. Promote absorption of fluid by elimination through kidneys in case of ascites.

5. Cause absorption of fat deposits.

6. Strengthen weak and relaxed abdominal muscles.

7. Break down adhesions.

8. Mechanically assist in moving on the contents of the colon.

## CHAPTER V

### FOOT DEFORMITIES; FOOT WEAKNESSES AND THEIR TREATMENT BY MASSAGE AND EXERCISE

Foot deformities may be congenital or acquired. In most instances those of the acquired type are the result of diseases in childhood. For example, the equinovarus condition is a usual deformity following poliomyelitis. If there is much structural change in the bones, and subsequently an adaptive overstretching and shortening of muscles and tendons, then an operation is usually the only method that will obtain favorable results.

Foot weaknesses in which the trouble rests principally in the muscles and tendons are often very successfully treated by physical therapeutic methods. The cause of the condition should receive first consideration. If necessary, shoes especially fitted to assist in overcoming the pernicious tendency should be obtained. Kneading of the foot and leg muscles, followed by passive, active, and positive resistive exercises given daily for several weeks, will prove advantageous. The patient should be warned to resume practice of the corrective exercises and positions from which benefit was derived, if signs appear of a recurrence of the trouble.

## ANATOMY OF THE FOOT

"The foot should be not merely a passive support, but an active organ of locomotion." The toes should normally be straight and capable of plantar flexion and extension, the great toe having freedom in dorsiflexion. Normal range of motion in dorsiflexion of the ankle-joint should be 70 to 80 degrees, with the knee extended and the forefoot inverted. The movements of pronation and supination are principally in the subastragaloid joint, the mediotarsal joints being free in all directions, but especially in adduction and abduction. Inversion and eversion of the whole foot are produced by pivoting the foot upon the heel. Inversion is the result of the action of the tibialis anticus and posticus muscles; eversion is the result of the action of the peroneal longus and brevis muscles. The short plantar ligament lies between the sustentaculum tali of the os calcis and the scaphoid. It acts as a supporting medium for the head of the astragulus. The two natural arches of the foot are known as the longitudinal and the transverse. The former is seen from the inner aspect and extends from the anterior part of the heel to the distal end of the first metatarsal bone. The highest portion of this arch corresponds to the highest point of the scaphoid bone. The transverse arch is formed by the distal ends of the metatarsal bones. A slight convexity is seen from the dorsum of the foot and a corresponding concavity on the plantar surface. The highest point of the transverse

arch is over the second and third metatarsal bones. A plumb-line may be used for testing abnormal positions of the foot in relation to the leg. Anteriorly, one end of the string is placed in the center of the patella, and the weight at the other end of the line should fall over the interosseous membrane of the second and third toe. Posteriorly, one end of the line is placed in the center of the popliteal space, and the weight should fall to the middle of the heel.

## FOOT DEFORMITIES

If much structural change has taken place in the foot, an operation may be performed whereby a wedge of bone is removed in order that better alinement of the tarsus may be gained. An operation on the tendons surrounding the joint is often necessitated by their having become overstretched as a result of a long-standing bony deformity. The foot is then placed in a plaster cast to maintain the corrected position. When the limb is taken out of the cast, massage and exercise are beneficial. Effleurage and kneading of the entire limb, with special attention to the muscles that have suffered most, precede exercise in which the foot is passively moved and actively encouraged to maintain the corrected position.

In a hallux valgus there is an enlargement of the metatarsophalangeal joint. A patient having a talipes varus deformity walks on the outer border of the

foot. A talipes valgus is just the reverse of varus, causing the patient to walk on the inner border of the foot. The patient with a talipes calcaneo walks on the heel.

Fig. 59.—Hallux valgus. Enlargement of the first metatarsophalangeal joint. (E. G. Brackett.)

Fig. 60. — Talipes varus with equino deformity in which the patient walks on outer border of foot with heel drawn up. (E. G. Brackett.)

In a talipes equino the heels are drawn up during walking. A pes cavus condition is one in which there is a hyperlongitudinal arch.

Fig. 61.—Talipes valgus, commonly known as flat-foot, in which the patient walks on inner border of foot. (E. G. Brackett.)

Fig. 62.—Talipes calcaneo, in which the patient walks on the heel, also showing clubbed toes. (E. G. Brackett.)

## FOOT WEAKNESSES

*Anterior Metatarsalgia.*—Normally, the transverse arch of the foot should be slightly concave on the sole, over the heads of the metatarsophalangeal joints. The tendon of the peroneus longus muscle passes under the tubercle of the fifth metatarsal bone and extends to the great toe, thus supporting the transverse arch. If metatarsalgia is present, the arch becomes convex, the tendon losing its power of support. Crippling pain between the tarsal bones is the result, and usually a great deal of callus forms over the heads of the metatarsal bones. Massage of the foot and leg is given, with special attention to the plantar surface, in which the short flexors of the toes are overstretched owing to a convexity of the transverse arch. The most beneficial exercise for this condition is that in which the patient stands with the heads of the metatarsal bones resting against a low rod, the toes gripping the rod. The effect of this exercise is strongly to contract the overstretched muscles on the plantar surface of the foot.

A felt pad strapped transversely and fitting snugly just at the back of the heads of the metatarsal bones will give temporary relief. This may be used until the plantar muscles regain their function so that the arch may be naturally maintained.

*Flat-foot* is the most common form of foot weakness. It is frequently caused by wearing faulty shoes or from getting overtired, especially if the person is stout.

The wearing of an entirely different kind of shoe or a sudden change from a sedentary life to one that calls for excessive use of the feet may be the cause of flat-foot. A combination of these causes is not at all uncommon.

Fig. 63.—Posterior view of flat-foot. (E. G. Brackett.)

Flat-foot is divided into three classes: Those in which the trouble is chiefly in the early stage of muscular weakness; those in which structural deformity is imminent; those in which bony deformity is present and often of long standing. Cases of the first type usually improve if treated by an alternate hot-and-cold foot bath twice daily, followed by massage of the plantar

muscles, the calf muscles, the peroneal and anterior tibial muscles, and by kneading of the thigh muscles. Passive, active, and positive resistive exercises for the toes and ankle-joints are given, inversion is emphasized, and eversion is omitted entirely. Even after a few treatments the pain is relieved, and improvement almost always follows a dozen treatments.

In the second type, if inflammation of the tarsal bones is present, hot packs and absolute rest are necessary, with no body weight borne on the feet until all signs of inflammation subside. Passive and positive resistive exercises to the toes and ankle-joint are given, particular emphasis being laid upon inversion of the ankle. All the exercises for this type of flat-foot should at first be given while the patient is in the lying position.

In the third type, if much bony deformity is present, massage and exercise are of little benefit, although corrective exercises have sometimes proved of value. In all cases of flat-foot the patient should never attempt to walk without having the heel of the shoe adjusted. Stress should be laid upon the necessity of wearing the Thomas heel, in which the inner side of the heel is raised from $\frac{1}{8}$ to $\frac{1}{4}$ inch, the inner side of the heel extending forward so as to support the plantar ligament. Any outside foot support should be used merely as a brace and should be discarded at the earliest opportunity. In cases of the first and second types the

muscles should be trained to take up their natural action by the aid of regular graduated exercises.

At the completion of the above-described treatment, if the patient is obliged to be on the feet a good deal,

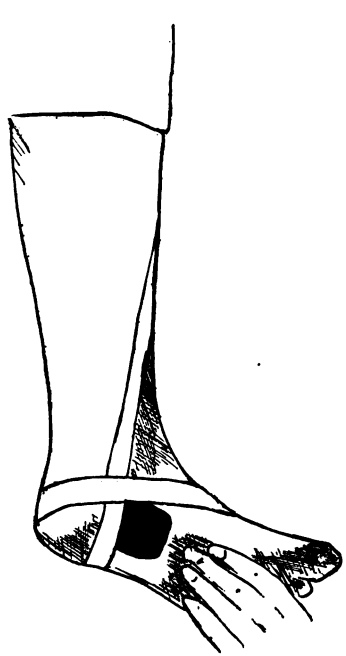

Fig. 64.—Showing application of the first two straps, foot inverted, and position of pad when strapping for flat-foot.

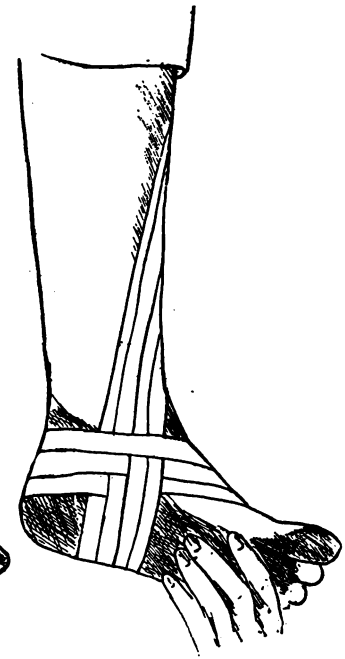

Fig. 65.—Showing the final position of the straps, internal aspect.

the application of adhesive strappings is sometimes used to assist in overcoming the tendency to pronation. A small felt pad is placed on the inner side of the heel.

The first strap passes from above the external malleolus, under the heel covering the pad, and is pulled tightly over the sole and the internal malleolus so that the foot is adducted and inverted. The second strap

Fig. 66.—Showing final position of straps, external aspect.

is placed transversely to the first and four or five straps each way are fixed alternately in the order described above. The longitudinal straps are about 15 to 18 inches long and about 1 inch wide, and the transverse straps are 10 or 12 inches long and 1 inch wide.

A list of graded exercises for flat-foot conditions is given below. These exercises may be divided into groups of six for one treatment. In this way a change of schedule may be obtained which is beneficial to the patient and prevents monotony.

## GRADUATED FOOT EXERCISES

1. Sitting, dorsiflexion of ankle, plantar flexion of toes, and inversion of soles of the feet.
2. Stride stand hips firm position, standing on outer borders of the feet.
3. Standing, picking up marbles with toes, placing marbles in basket. (Keep a score.)
4. From stride stand position, right foot forward placing, left foot outer edge, toes turned in, bend knees slowly and return.
5. Sitting in corrective position, with knees abducted and legs crossed, feet resting on the outer border.
6. Walking on outer border of foot, toes turned in, one foot in front of the other, forward and backward.
7. Standing, marble relay race.
8. Sitting on floor, knees abducted, throw and catch tennis ball with soles of feet inverted.
9. Standing, foot placing sideward, heels firm, abduct until toes meet, rotate the feet on the heel.
10. Correct walking, heel touching first, but without body weight, which is transferred to the outer border of the feet, feet parallel, as in Indian walk.

11. Sitting, extending, inverting, and flexing the ankle-joint, grasping the ankle with the hand.

12. Sitting on chair, knees abducted, legs crossed, feet on outer border, rise and sink.

13. Prone falling position, stretch the tendon of Achilles by grasping bars or table, keeping heels on floor.

14. Standing, toes turned in, rise and sink. (Not to be given until the muscles of the foot are well developed.)

15. Standing, foot placing sideward, raise on toes, press to outer border, and sink.

16. Sitting, knees stiff, extending, inverting, and flexing ankle, curling up the toes in plantar flexion. A distinct pause should be made between each movement.

# CHAPTER VI

## SPINAL CURVATURE: EXERCISES FOR KYPHOSIS AND LORDOSIS; THERAPEUTIC EXERCISES FOR WEAKNESS OF BACK MUSCLES

### SPINAL CURVATURE

THERE are four natural curves in the spine. Two are called primary curves, and two secondary. The child is born with a dorsal and sacral convexity from the posterior aspect. The cervical curve appears when the child learns to extend the head. The lumbar curve shows signs of appearance when the child begins to walk. If the natural curves are increased, reversed, or the spine as a whole deviates from the straight line, a pathologic condition occurs which is known as spinal curvature. In general, there are three forms of curvature of the spine—the kyphotic, in which there is an increased upper dorsal convexity posteriorly; the lordotic, in which there is an increased lumbar convexity posteriorly; and the most common type, in which there is a lateral deviation of the spine. Spondylitis, or Pott's disease, in which there is inflammation of the vertebræ from tubercular or other causes, may be the occasion of the curvature. In any type of caries of the spine the patient is usually placed in a cast in order that rest may facilitate the subsidence of the inflammatory processes.

Manipulation and exercise are strongly contraindicated in such cases.

*Kyphosis.*—In kyphosis there is an exaggerated backward convexity of the normal dorsal curve. The head

Fig. 67.—Kyphosis and lordosis, also showing sunken chest and sagging of the abdominal viscera. (E. G. Brackett.)

and shoulders are held in the forward position, and the stooping posture is usually compensated for by an increase of the normal curve of the lumbar spine. This

compensation is the natural way of re-establishing the equilibrium of the spine and of bringing the body back to the normal plane. Kyphosis is the first position of slump posture. Posture training, along with corrective exercises of an active and resistive nature, with emphasis on diaphragmic breathing, is the most beneficial form of treatment.

*Lordosis.*—In lordosis there is an increase of the normal lumbar curve. This condition is frequently a secondary one following kyphosis, and is the final stage of the slump posture. Positions and exercises for posture training are described in Chapter IV of Part II.

An outline of exercises is given below, from which other groups of exercises may be developed according to the individual needs of the patient. These exercises are divided into three groups—one set for kyphosis, one for lordosis, and one for increasing the flexibility of the spine.

## THERAPEUTIC EXERCISES FOR WEAKNESS OF BACK MUSCLES

I. *Exercises for Kyphosis:*

(1) Tense bendings.

Types:

1. Head bending backward.
2. Backward bending of upper trunk. (Lifting of chest.)
3. Exaggerated good standing posture.

(2) Dorsal activities.

Types:

1. Standing, trunk bending forward.
2. Exercises in fall-out position, combining arm and foot movements.
3. Balance toe support standing.
4. Transverse prone lying.
5. Exercises in horizontal foot grasp position.

(3) Respiratory exercises.

Types:

1. Arm raising.
2. Hand turning.
3. Arm circling.
4. Bend standing arm stretchings.
5. Exaggerated stretching position.

(4) Heave movements.

Types:

1. Movements in which the weight of the body is suspended by the arms.
2. Movements in which the weight is partially supported by the feet.
3. Movements for the abdominal muscles from the hanging position.
4. Movements involving nearly all parts of the body, the weight being carried by the arms part of the time.

5. Serpentining group-mixture of heave and lateral trunk movements.
6. Play forms, for example, hand tag, playing with double rings.
7. Arm stretching to be used if no apparatus is available.

II. *Exercises for Lordosis:*

Types:

1. Lying touching the floor with the lumbar vertebræ.
2. Standing against wall touching wall with buttocks and dorsal spine, and attempting to touch with lumbar spine. Measure the distance of feet from wall.
3. Lying, knees bent, hands on abdominal wall. Let hands approach vertebral bodies, then push the hands up by abdominal muscles as hard as possible.
4. All lying leg raisings, attempting to keep the lumbar vertebræ on floor.
5. Single knee bending, leg stretching and sinking.
6. Double knee bending, leg stretching, bending and lowering.
7. Single leg raising and lowering without bending the knee, attempt strongly

to keep the small of the back on the floor.

8. Double leg raising and lowering without bending the knees.
9. Prone falling, executed deliberately.

III. *Exercises for Increasing the Flexibility of the Spine:*

Types:

1. Head circumduction.
2. Head flexion and extension.
3. Head side flexion.
4. Stride standing, arms stretching sideward, trunk bend forward and downward.
5. Stride standing, trunk bending forward 45 degrees, arm flinging from arm bend position.
6. Stride standing, trunk bending forward, touching floor without bending knees.
7. Blocking step. Body turning from reach standing position, two people grasping hands.
8. Trunk twisting, from trunk bending forward.
9. Trunk circumduction.
10. Stride standing, arms stretching sideward, trunk twisting.
11. Stride standing, arms stretching side-

ward, trunk bending sideward, alternately right and left.

12. Sitting, trunk twisting.
13. Sitting trunk bending sideward.
14. Hanging from stall bars, climbing stall bars rapidly.
15. Head suspension.
16. Rest standing, trunk twisting from side to side very rapidly.
17. Sitting on floor, trunk bending forward.
18. Swinging on double rings, body circumduction: (*a*) Lifting feet from floor. (*b*) With feet on floor.

## CHAPTER VII

### SPINAL CURVATURE (Continued): EXERCISES FOR LEFT TOTAL CURVATURE; EXERCISES FOR SCOLIOSIS (RIGHT DORSAL LEFT LUMBAR)

LATERAL curvature or scoliosis is a condition in which there is flexion, sidebending, and rotation of the vertebræ on their vertical axes. In the kyphotic and lordotic types of spinal curvature the deviation is of an anteroposterior character, but in scoliosis the deviation is also lateral. Scoliosis is too frequently not discovered until some structural change has taken place in the spine.

The causes of lateral curvature are obscure. Predisposing conditions are astigmatism, infantile paralysis, weakness of the back muscles, general constitutional weakness, and faulty positions, especially of children at their desks in school. The bilateral muscles that maintain the equilibrium of the spinal column lose their balance, so that contraction of the erector spinæ group takes place on one side of the column and overstretching on the other side. Owing to the strain of this irregular muscular action the spinal column bends, yielding to the pull of the contracted muscles. Lateral bending may be either to the right or left, and may take place in the cervical, dorsal, or lumbar regions.

A total or **C**-shaped curve may extend the whole length of the spine. It is more prevalent as a left total curve. This is often the incipient stage of a double curvature. At this stage the spinous muscles and ligaments are chiefly affected. Hippocrates (460 B. C.)

Fig. 68.—Left total curve. (E. G. Brackett.)

described lateral curvature of the spine as a scoliosis, which is a Greek word meaning to twist or to bend. It is acknowledged that bones will adapt their contours and positions according to the pressure which is brought to bear upon them, and this is especially true during the growing period. In a scoliosis there is a flexion, side

bending, and twisting of the vertebræ on their vertical axes. When the spinal column is flexed and bent to either side, the bodies of the vertebræ rotate toward the convexity of the curve.

Fig. 69.—Scoliosis (right dorsal, left lumbar curve). (E. G. Brackett.)

Doctor Lovett, of Boston, Mass., in his book on "Lateral Curvature of the Spine," demonstrates by experiments upon a living model and a cadaver the difference in the rotation of the bodies of the vertebræ. The right hip of the cadaver is raised so that the spine is

bent to the left side. The upper part of the column being free, is pulled over by the force of gravity. The bodies of the vertebræ rotate toward the concavity of the curve. In the living model, if the right hip is raised the spine is bent to the left. The upper part of the column, instead of gravity pulling it to the left, equilibrium counteracts the pull of gravity, and, in consequence, the upper part of the column is bent to the right. In this instance the bodies of the vertebræ are rotated toward the convexity of the curve. In the living model the balance sense has subconsciously reversed the twist of the bodies of the vertebræ so that the convexity of the curve is upon the opposite side from the lateral deviation.

Dr. E. G. Abbott, of Portland, Maine, claims that a scoliosis or a pathologic curve resembles a physiologic curve in appearance, as has been demonstrated by *x*-ray and skiagram. The only difference is that in a pathologic curve the resumption of the normal position of the spinal column is impossible, but in a physiologic curve the position of the normal spine may be assumed at the will of the individual. Dr. Abbott speaks of the physiologic curve being a natural rest posture, in which the spinal column is flexed and bent to one side, the bodies of the vertebræ being rotated to the convexity of the curve. The claims that the tilting and unevenness of the shoulders and hips in this rest posture resembles in every respect a true scoliosis.

The most common form of double or S curvature is that in which a few upper dorsal or lower cervical and upper dorsal vertebræ bend to the right. A compensatory curve in the opposite direction in which the bodies of the vertebræ rotate to the convexity of the curve takes place in another part of the spinal column. This compensatory curve is a natural way of restoring the equilibrium of the body. Concavities are always opposite convexities and *vice versa*. A curve may originate at either end of the spinal column. The cervical and lumbar regions being the more flexible parts of the column, the first signs of curvature frequently appear in these regions. If the curve starts in the cervical region, then the lower dorsal curve is the compensatory one. If the curve starts in the lumbar region from unequal support of the pelvis, the dorsal will be the secondary curve.

There has been much discussion about the treatment of spinal curvature, and even authorities disagree. Except in the most incipient cases, before any definite structural deformity has taken place, treatment by exercise alone is of little or no use. In the very early stage of the trouble massage of the back accompanied by daily performances of symmetric exercises will help to strengthen the weakened muscles. Deep breathing and hanging exercises, either from a horizontal bar or by means of the Sayre head apparatus, may be used to advantage.

## LIST OF EXERCISES FOR A LEFT TOTAL CURVE

1. Wing stride standing, head bending backward, with deep breathing.

2. Tall stretch standing, placing right hand on back of neck, left hand on hip, with deep respiration.

3. Same position assumed as in preceding, trunk to the left bend.

4. Stride standing with arms bending upward. Right arm upward, and left arm downward stretch.

5. Balance walking, with a bag of beans carried on the head.

6. Sayre suspension apparatus, by means of which the body is slowly raised from the ground.

7. Wing lax stoop stride sitting, trunk raising.

8. Prone lying feet supported, trunk raising. For progression, the body from above the waist may hang over the head of the plinth.

9. Throwing volley or basket ball overhead and from concave side (work up speed).

10. All hanging exercises. Reverse the exercises for a right curve.

Dr. Klapp advises the knee-hand position in which the patient creeps on the hands and knees. The hand of the side of the concavity is thrust forward as far as possible with each forward movement.

The patient should be instructed to commence all exercises by first adopting the keynote position. This is a position in which the patient is encouraged in self-

correction by placing the arms in various ways according to the type of curvature. In this way contracted muscles are stretched and overstretched muscles are contracted. The principal object of the keynote posi-

Fig. 70.—A keynote position. The patient is making a strong voluntary effort to correct deformity by voluntary effort. The hands are placed in the best position for corrective muscular pull. (E. G. Brackett.)

tion is to educate the patient to overcome the deformity by voluntary muscular effort. The patient should be encouraged to assume this corrective position several times a day when at home as well as in the gymnasium.

Dr. E. G. Brackett, of Boston, uses an apparatus which is a combination of the Sayre head sling and his own idea of the combination of suspended dumb-bells. The patient either sits or stands; preferably from the sitting

Fig. 71.—Another keynote position. (E. G. Brackett.)

position the dumb-bells are pushed up forcibly by the patient, with the elbows bent. At the same time the operator slowly raises the patient by means of the pulley which controls the head sling.

Dr. Abbott has devised a frame whose method is the

overcorrection of the patient's deformity. Following the exercises just described the patient may lie in the hammock of this frame for thirty minutes daily follow-

Fig. 72.—Head sling and suspended dumb-bells. (E. G. Brackett.)

ing special exercises. In the incipient stage this is helpful in preventing the further development of the condition, and if the treatment is faithfully followed,

muscular balance may be restored. An outline of special exercises, one for a total left curvature and one for a double curvature, right dorsal left lumbar, are given below. Exercises before the overcorrection cast is applied and after the removal of the cast are an essential part of this treatment. During the period of using the cast, which may last a year or two, daily systematic movements of the upper and lower extremities, accompanied by deep breathing exercises, have been found extremely beneficial to the patient.

### LIST OF EXERCISES FOR A RIGHT DORSAL LEFT LUMBAR CURVE

1. Exaggerated corrective stretching posture. Right hand pressed against convex ribs under axilla, left hand on hip, and deep breathing.
2. Lying single and double, knee bending, stretching, bending and lowering slowly.
3. Standing heel raising and knee bending, bend stride standing, arm and forearm flexion and extension.
4. Stride standing sawing.
5. Spring sitting, left leg bending forward, left arm stretching forward and upward, right arm stretching backward and downward along the side of the posterior thigh.
6. Sayre head suspension apparatus.
7. Bend stride standing, arm stretching sideward and upward.

8. Prone lying, feet supported, trunk raising. For progression the body from the waist up may hang over the head of the plint, arm flinging.

9. Swinging on double rings. (Play forms only.)

10. Hanging from double rings feet together on floor, body circumduction.

Reverse the exercises for a left dorsal right lumbar curve. Daily symmetric exercises should be taken regularly for two or three months before improvement may be expected. Kneading and effleurage of the muscles of the back, following exercises, will help to strengthen the back muscles. After all exercises for spinal curvature the patient should rest for thirty minutes, preferably in the prone lying position, by which means the weight of the body is taken off the spine. Resting after exercise is an essential part of the treatment and should not be overlooked.

# CHAPTER VIII

## EMPYEMA: EXERCISES IN CASES OF CONVALESCING EMPYEMA. HERNIA: EXERCISES IN CASES OF HERNIA

### EMPYEMA

It is quite common for an acute case of pneumonia to be followed by a purulent effusion in the lungs. After the acute stage has passed and during the convalescing period absorption of fluid may be hastened by therapeutic exercises. Stretching exercises are used on the affected side in order to prevent adhesions from forming or to break down those already formed. The lungs should be gently and gradually expanded by deep breathing exercises, which will also increase the mobility of the chest walls. The lower trunk muscles may be strengthened by the use of abdominal exercises accompanied by diaphragmic breathing. The lower trunk muscles, on account of decreased involuntary exercise, lack tonicity because of labored and limited breathing. As a consequence, the general physical condition suffers. Constipation and general ptosis result from the weakened condition of the abdominal muscles.

The patient should be taught how to take deep breaths, so that the base of the lung on the affected side

may be thoroughly aërated. The stoop bend sitting position, combined with trunk rotation to the opposite side, is beneficial in stretching the lung on the affected side to its fullest capacity. The patient is asked to take long, deep breaths while the operator offers resistance through the action of the intercostal muscles, by placing the hand over the affected area. In this way the ribs are more fully expanded during inspiration, and constricting fibrous bands are not allowed to become firm.

At the Walter Reed General Army Hospital in Washington, D. C., many operative cases of empyema were helpfully treated by exercise during the convalescing stage. Even after the resection of several ribs, in cases in which the hollow chest and spinal curvature symptoms were present, much benefit was derived from daily systematic exercise. Gentle breathing exercises were started even before the drainage-tubes were removed. All exercises, except in unusually stormy weather, were given out of doors and in class formation.

Tuberculosis not infrequently follows as a result of empyema. Therefore special emphasis is laid upon thorough aëration of the upper part of the lungs, as the bacillus is often harbored in this region. All breathing exercises should be carried on out of doors and the patient directed to make a regular habit of deep, slow, rhythmic breathing.

## A FEW GRADED EXERCISES FOR CONVALESCING EMPYEMA

*Fundamental Standing Position:*

1. Stride standing, head bending backward,with deep breathing, holding the breath slightly at the end of inspiration.

2. Stride standing, arms bending forward and stretching, with slow, deep breathing.

3. Stride standing, alternate knee bending and stretching (two movements to each respiration).

4. Stride standing, trunk bending forward and raising (deep inspiration during trunk raise, expiration on trunk bend position).

5. Stride standing, trunk bending sideward away from affected side, with deep breathing.

6. Stride standing, arms raising sideward, trunk bending sideward away from the affected side. The affected side should be pushed out during inspiration, and slowly returned to position during expiration.

7. Arm stretching forward, sideward, and downward, with deep, slow breathing, with the feet in the stride stand position.

As a mark of progression in exercise treatment for cases of convalescing empyema the stride stand position is replaced by the close stand position. The above exercises from Nos. 1 to 4 should be given from five to ten times each. Numbers 5, 6, and 7 should be given from five to twenty times.

## HERNIA

Hernia is almost always the result of weak abdominal muscles, in which a protrusion of the abdominal viscera occurs through the internal and external abdominal rings. The internal oblique muscle originates from the lumbar fascia, from the anterior two-thirds of the middle lip of the crest of the ilium and the outer half of Poupart's ligament, and is inserted into the cartilages of the four lower ribs. Its aponeurotic insertion is continuous with the linea alba. The internal abdominal ring lies just beneath the lowest border of the transversalis muscle, and the lower fibers of the internal oblique muscle cover the internal abdominal ring. The development of the internal oblique acts as a defense in guarding this ring. The transversalis muscle lies deepest of the abdominal muscles. It originates from the outer third of Poupart's ligament, from the anterior two-thirds of the inner lip of the crest of the ilium, and the cartilages of the six lower ribs. By its aponeurosis it is attached to the linea alba and by a conjoined tendon with the internal oblique into the crest of pubes and the pectineal line. The external oblique muscle-fibers originate from the eight lower ribs by eight fleshy slips and is inserted into the anterior half of the outer lip of the crest of the ilium by a broad aponeurosis, into the ensiform cartilage, linea alba, symphysis, and spine of pubes and pectineal line. The lower part of the aponeurosis forms Poupart's and Gimbernat's liga-

ments. The separation of the fibers of the external oblique form the external abdominal ring. An operation is frequently necessary in order to replace the protruded portion of the abdominal viscera. Following the operation exercises are most helpful for strengthening the abdominal muscles and thus preventing a recurrence of the trouble.

Of the two forms of hernia—femoral and inguinal—the latter is by far the more common. Femoral hernia indicates a dilatation of the femoral sheath through the femoral ring. In an inguinal hernia there is a stretching apart of muscle and tendon. In threatened cases of hernia active exercises, in which the external, internal oblique, and transversalis are strengthened, will act as a preventive measure. After operation, as soon as the surgeon will allow, light abdominal exercises in the form of diaphragmic breathing, and exercises that call for movements of forced inspiration are given. The general musculature should be toned up by light gentle exercises such as are given in cases of general debility. Too much stress cannot be laid upon deep breathing, as the strengthening of the abdominal muscles is the principal factor. By deep breathing exercises the abdominal viscera are drawn up and the pressure on the abdominal muscles is relieved. A truss should be worn during exercise for the purpose of maintaining a continual pressure over the abdominal rings.

## THERAPEUTIC EXERCISES FOR HERNIA

The patient is in the prone lying position, head and shoulders well raised. In a left-sided hernia the right hand should be placed behind the neck, the trunk twisted to the right. Compression either by the fingers or truss is maintained throughout the exercise over the inguinal canal and external ring. In a right-sided hernia the trunk is twisted to the left. If there is a hernia on each side the twist should be to each side, care being taken to maintain compression over the abdominal rings.

With the patient in the stride stand position, and the abdominal muscles well contracted, the trunk is flexed on the hips, the movement being accomplished by positive action of the anterior abdominal muscles and the hip flexors. To maintain balance and counteract the force of gravity there is then a negative contraction of the hip extensors. With the abdominal muscles still well contracted the patient begins to flex the spinal column upon itself, commencing in the cervical and passing down to the lumbar region. This exercise is accomplished by a contraction of the anterior chest and abdominal muscles, and by the elasticity of the intervertebral disks of fibrocartilage in the spinal column. Balance is again maintained by a negative contraction of the erector spinæ group.

This exercise should be simplified by separating the two parts and giving only the flexion of the trunk on the hips, until the patient is thoroughly aware of the

importance of keeping the abdominal wall tense throughout the second part of the exercise, as the relaxing of these muscles will permit a sagging of the abdominal viscera, the danger of which cannot be too carefully emphasized. After each movement the return to the original position is accomplished by a positive action of the erector spinæ muscles, followed by that of the hip extensors. The straightening of the spine must take place before the extension in the hip region, in order to maintain the contraction of the abdominal muscles until the completion of the exercise.

Besides the muscles actually used in executing this exercise, many of the muscles of the leg and thigh are also in a state of static contraction, in order to maintain balance throughout the exercise. The extensor quadriceps group are contracted in order that the knees are held firm against the pull of the hamstrings. In the muscles of the ankle-joint there is a similar contraction of the opposing muscle groups.

The difficulty of this exercise may be varied by changing the position of the arms, the least difficult position being that in which the wing stand position is used. In this position the abdominal viscera is supported and the center of gravity in the body is low. This exercise is made more difficult the higher the arms are raised, because of the center of gravity in the body being raised also. The most difficult variation of the exercise is with the arms in the upward stretch position

in which the center of gravity is as high as possible, and the balance of the body is the most difficult to maintain.

The abdominal organs are stimulated by this exercise due to the alternate pressure and release from pressure of the muscles on the abdominal viscera. The venous and lymphatic flow are increased in the abdomen and thorax, while the flow in the inferior vena cava and the thoracic duct are promoted, because these structures closely follow the movements of the vertebral column on account of their proximity to it. With the arms in an upward stretch position the venous flow is assisted by means of gravity. The spinal cord is stimulated and the flow in the veins hastened by the alternate lengthening and shortening of the spinal cord. The legs, abdomen, thorax, spinal column, and the arms are all affected by this one exercise and its variations.

# CHAPTER IX

## CARDIOVASCULAR DISTURBANCES: THEIR TREATMENT BY THERAPEUTIC EXERCISES

THE nervous mechanism of the heart is partly nervous tissue and partly a special form of heart muscle, It is reasonable to expect that an improved state of balance between the vagus and the accelerans nerves will result in a more regular pulse-rate. At the junction of the superior vena cava and the right auricular appendix is the sino-auricular node. This is an aggregation of neuromuscular tissue which initiates the stimulus and sets both the pace and the rhythm of the heart. It is generally supposed that this node derives its fibers from both the sympathetic and the cerebrospinal systems. The way in which the stimulus passes to the walls of the auricles and ventricles is not fully understood; but possibly it is conveyed by the action of the heart muscle, regular and complete contraction of which is necessary for regular contraction of the ventricles. The auricular-ventricular bundle, which lies on the right side of the auricular septum, next receives the stimulus, and from this node the stimulus is carried to the auricular-ventricular bundle, and from thence to the ventricles. Irregular and incomplete contraction of the auricles results in irregular contraction of the ven-

tricles. In abnormal conditions the stimulus may not originate in the sino-auricular node, but in other parts of the nervous mechanism; for example, in premature systole the stimulus may arise in the auricle or the ventricle.

In cases of heart weakness, whether they be functional or organic, the patient may derive much benefit from carefully graded exercises, given under medical supervision. As a preliminary the physician should make a thorough examination of the patient's heart by means of the stethoscope, the blood-pressure should be taken, and, if possible, the pulse-rate should be recorded by the cardiograph. Among the benefits to be derived from these exercises an improved condition of the circulation, respiration, digestion, and elimination may confidently be expected. Regular, systematic exercises, accompanied by rhythmic breathing, will help to give tone to cardiac muscle.

Improved nerve control is also very noticeable in cases in which there is a marked neurocirculatory disturbance. When the inhibitors gain better control, exertion will not produce an abnormal pulse-rate. After a few weeks of regular daily treatment it will be noticed that the pulse-rate almost invariably will be lower after exercise than before. Knowledge of this fact will also be of benefit to the patient in affording him an increase of self-confidence.

In the treatment of heart cases the operator must

consider the peculiarities the individual patient possesses. Should undue pallor or a bluish cast appear on the lips, the exercises should be suspended until medical examination indicates that there is no danger in proceeding. Almost always in circulatory cases improvement will be noted in a week or two. Then exercises of a more strenuous kind may be introduced, until finally a regular "jog trot" is reached. In the Nauheim-Schott and Oertel methods patients are given daily progressive walks with light hill-climbing, the physician prescribing the length of walk, and also the combination of steps and breathing. In the beginning one or two steps are taken during each phase of respiration. With increased practice, while walking up hill, the patient may sometimes reach three steps during inspiration and expiration, without showing signs of fatigue. Oertel teaches his patients to interrupt expiration two or three times if any sign of palpitation appears. He claims that this will have a direct mechanical influence on the heart.

Any exercise in game form that employs the larger muscle groups is beneficial, provided overexertion is carefully guarded against. During the convalescing period rowing, cycling, and golf, for which the graded exercises have served as a preparation, are especially helpful. Hypertrophic degenerative changes may have taken place in the heart muscle, in which case dilatation would render compensation impossible.

Sir William Stokes, about 1850, speaks of mountain

climbing producing hypertrophy of the heart muscle, just as exercise will strengthen the skeletal muscles. In his article, "Diseases of the Heart," published in Dublin in 1854, he makes the following statement: "The symptoms of debility of the heart are often removable by a regulated course of gymnastics or by pedestrian exercises, even in mountainous countries as Switzerland and the Highlands of Scotland and Ireland." Diet rich in albumin was recommended by Stokes, but fluids were to be taken as sparingly as possible. He recommended avoiding the terrain-cure in cases of advanced arteriosclerosis.

In valvular disease, if degeneration is present and compensation fails, the diminished circulation in the arteries causes a congestion in the capillaries and veins on account of the failure of the heart to empty itself. This condition cannot usually be greatly assisted by therapeutic exercise. The local condition, however, may be helped by the general improvement in the circulation.

A system of grades of exercises for cardiovascular disturbances has been found helpful. The patient is placed in the grade to which he is best suited, and progresses from one grade to the next as his condition improves. An outline of the five grades that have been used with much success is given below. Two cases of cardiovascular disturbances have been added. In these cases the diagnosis and the pulse-rate both on entering

and leaving class is given. This report shows the different figures registering the pulse-rate both sitting and standing, before and after exercise. The figures show a lowering of the pulse-rate after exercise. This was not only temporary, but showed a slightly lower rate one hour after treatment.

### EXERCISES FOR CARDIOVASCULAR DISTURBANCES

These exercises may be used for individuals or for classes.

Grade I. Patient is seated or in the half-lying position. Every exercise in Grade I is given with slow rhythmic breathing.

1. Passive flexion and extension of wrist.
2. Passive flexion and extension of elbow.
3. Passive flexion and extension of shoulder.
4. Passive flexion and extension of ankle, knee, and hip.

In this group the operator begins with passive, followed by assistive movements, gradually working up to resistive.

5. Active flexion and extension of the elbow, shoulder, knee, and hip, accompanied by slow, rhythmic breathing.
6. Finish with active arm stretchings, with palm turnings, accompanied by slow, rhythmic breathing.

Grade II. Exercises in the lying and sitting positions. These should be accompanied by rhythmic breathing of a slightly faster time than for those in Grade I.

Standing position:

1. Arm bending and stretchings with deep, rhythmic breathing.

2. Shoulder, neck, and back exercises with deep, rhythmic breathing.

3. Balance exercises, knee bending and stretching, with deep, rhythmic breathing.

4. Alternate trunk movements with deep, rhythmic breathing.

5. Deep, rhythmic breathing for ten or fifteen counts.

Grade III. Standing position:

1. Head bending with rhythmic breathing.

2. Shoulder, neck, and back exercises on command, normal breathing.

3. Balance exercises, and exercises for co-ordination.

4. Alternate trunk.

5. Deep, rhythmic breathing (rhythm slightly faster than in Grade II).

In balance and co-ordination exercises, one individual movement to each inspiration, and exercises gradually increased to a maximum number of movements to each respiration.

Grades IV and V. Regular distance walking and running prescribed daily, distance and speed being increased until an incline may be introduced without causing fatigue. Supervised games of a more strenuous nature.

## TWO TYPICAL CARDIOVASCULAR CASES TREATED BY THE GRADED EXERCISES DESCRIBED ABOVE, WITH THE RECORD OF PULSE AND IMPROVEMENT IN EACH CASE

Lieutenant-Colonel B.—*Diagnosis:* Functional cardiac disorder, postinfective type. Nervous; short of breath on exertion; slight effort causes marked increase in heart-rate.

Pulse on entering class, July 16th: Before exercise, sitting 116; standing 130. Pulse, July 28th: After exercise, sitting 72; standing 76. Marked improvement in pulse-rate. Much less increase in rate while standing. Colonel B. continued in class some time with more or less irregular heart-rate from day to day. Before returning to duty, early in September, he was taking part in indoor baseball, batting, running, and fielding.

Private P.—*Diagnosis:* Postdiphtheric paresis of legs. Functional cardiovascular disability; extrasystole. Gunshot wound, right leg. Foot strain.

Pulse-rate on entering the class July 17th was 116. Pulse-rate, August 1st: before exercise, sitting 72; standing 80. After exercise, sitting 72; standing 76. One hour after exercise was not transient.

In these cases the decrease of pulse-rate after the exercises was notable for its constancy.

The average pulse-rate for classes was:

Grade II, July 28th: Before exercise, sitting, $85\frac{2}{3}$; standing, $102\frac{2}{3}$; after exercise, sitting, 80; standing, 93.

August 5th: Before exercise, sitting, 81⅔; standing, 91; after exercise, sitting, 79; standing, 84⅔.

After exercise, July 28th, pulse increases on standing 13; on August 5th, 5⅔. It was found on examination one hour after exercise that the pulse-rate in most cases was still lower than immediately after exercise.

Grade III, July 28th: Before exercise, sitting, 85½; standing, 98; after exercise, sitting, 84; standing, 92. August 5th: Before exercise, sitting, 86; standing, 92; after exercise, sitting, 82; standing, 86½.

# CHAPTER X

## EXERCISES FOR ATAXIC CONDITIONS (TABES DORSALIS); SPASTIC PARALYSIS (HEMIPLEGIA)

### ATAXIC CONDITIONS (DR. FRENKEL'S EXERCISES)

TABES dorsalis, or locomotor ataxia, is a degeneration of the posterior columns of the spinal cord; therefore, the sensory nerves are affected. All treatment should aim to encourage the other senses to compensate for the loss of the tactual sense. If "shooting or lightning" pains are felt, a short period given to gentle stroking of the affected limbs may have a sedative effect before any exercises are given. If no pain exists, massage may be omitted, but exercise has a very important place in the treatment.

In his exercises for tabetic patients Frenkel's idea is to substitute healthy nerves for the affected ones, as much as possible, thus helping to restore disturbed function. This is purely compensatory, educative treatment. The patient's attention must be continuously held by the operator. It is better to have two periods of ten minutes' exercise twice daily, than to have a longer period at one time. This is especially true at the start. The patient should never be overtired, or

the movements will become less co-ordinated. The dosage in exercise may be gradually increased with safety. Frenkel divides his exercises for tabetic ataxia into four divisions: Those given in the lying position, the sitting position, the standing position, and the walking position. In the lying position the head and shoulders should be raised. The patient is instructed to concentrate his attention on each movement. Each of the following movements should be performed slowly three or four times:

1. Lying position:

(1) Flexion and extension of each leg at the knee- and hip-joints. Abduction and adduction of the bent leg, which should finally be slowly and deliberately extended.

(2) Both legs moved together, same exercise as in foregoing.

(3) Flexion and extension of one leg at a time with the heel raised from the bed.

(4) Leg flexed and heel placed upon some definite part of the other leg; for example, on the patella, the middle of the leg, ankle, and toes. These exercises may be given by changing the heel from one position to another, or else by calling for extension between different placings.

(5) Leg flexed, heel placed on knee of other leg, flexed leg gliding down the tibia to the ankle-joint.

(6) Leg flexed, heel placed on knee of other leg,

flexed leg gliding down and up the tibia to the knee, then slowly extended.

(7) Flexion and extension of both legs, with knees and ankles held close together.

(8) Flexion of one leg during extension of the other.

(9) Flexion or extension of one leg during adduction or abduction of the other.

When the performance of the above exercises becomes easy, the patient should repeat them with the eyes closed.

(10) The patient is instructed to try to place his foot in the hand of the operator while the operator constantly changes the position of the hand. Exercises may be given by means of special apparatus, consisting of a board with holes in which to place the heels and a bar which may be placed across the bottom of the bed at different heights and varying distances. The patient is encouraged to place his heels in the holes, the position of the board being changed after each attempt.

2. The patient maintains the fundamental sitting position for a few minutes at a time.

(1) Raising each knee alternately and placing foot firmly on the ground upon a traced footprint.

(2) Adduction of knees between other exercises.

(3) Patient is taught to rise from a chair and sit again with knees held together.

3. Standing position:

(1) Foot placings forward and backward on a straight line first with foot slightly raised, gradually getting to high step walking. These exercises should be followed by walking maneuvers; *e. g.*, walking along a zigzag strip.

If the upper extremities are affected, writing and drawing exercises are helpful. Holes marked, colored, and numbered on a board, the patient is asked to place his finger on a certain color and a number at a point of command. These exercises are beneficial for co-ordination and deliberate action building. In order to improve general benefit to the constitution, trunk flexions and extensions with deep breathing will aid systematic circulation, and so encourage both the flow of blood and lymph through the deep muscles of the back, thus aiding nourishment around the spinal roots of the nerves.

## PROGRESSIVE COMPETITIVE EXERCISES IN CASES OF SPASTIC PARALYSIS (HEMIPLEGIA), BASED UPON DR. SHEPERD IVORY FRANZ'S THEORIES

### HEMIPLEGIA

Hemiplegia is discussed in Part I, Chapter VIII. Dr. Sheperd Ivory Franz, of Washington, D. C., was interested in observing the exemplification of his ideas of competitive game exercises upon returned soldiers who were being treated for hemiplegia at the Walter Reed General Army Hospital. These exercises should be given twice daily. A baseball team for hemiplegics not only found much favor among the patients, but

showed some excellent results from both the mental and physical standpoints.

1. Wall test: The patient is instructed to swing the spastic arm until tired in flexion and extension, and to touch the wall. A mark on the wall should be made at the highest point reached, and the patient encouraged to reach a little higher each day.

2. The patient holds a tennis ball in the hand.

(*a*) Drops ball maximum number of times in three minutes.

Ball is placed in hand by operator.

Ball is placed in hand by patient.

(*b*) Stands on a line, swings arm and throws ball in basket.

Count number of times:

Ball is dropped back of line before thrown.

Is unable to release on extension or swing of arm.

3. The patient kicks football five times.

4. Chalk lines on floor, with numbered divisions:

| | | | | |
|---|---|---|---|---|
| 1 | 3 | 5 | 3 | 1 |

The patient stands 10 feet from target: Kicks tennis ball, twenty-five trials, and score is kept. Start with ten trials or less.

5. Exercise with hand same as No. 4 for foot. This exercises the relaxed extensor groups.

6. Step over stringed jumping standard; keep record each day of height.

7. Hand dynometer, a two-minute rest should be observed between trials:

(*a*) Weak hand four times alone.

(*b*) Weak hand four times, during which time the other hand grips something.

(*c*) Chest dynometer four times.

8. A volley ball is used for the following exercises:

(*a*) Catch ball with arm. Score should be kept.

(*b*) Throw ball in basket (which is placed in a low position) with both hands. Keep score.

9. Run (record time and distance) from a few steps to twenty-five meters.

10. Bat baseball. Score number of hits.

A daily record should be kept for each patient. Hard balls should never be used, for fear of hurting the patient.

### BASEBALL FOR HEMIPLEGICS

If a number of men suffering from spastic paralysis can be arranged into groups and a baseball team organized, this form of recreation is definitely therapeutic. The psychologic effect of competition is beneficial physiologically because of the excitation which enters into the game spirit. Voluntary motion in this way is obtained. The self-confidence resulting from the game is in itself a tremendous factor in the process of re-education.

## APPENDIX

THIS system of exercises for grades of disabilities was used in the Military School Hart House, Toronto, Canada.

### CLASSIFICATION FOR REMEDIAL EXERCISES

**Group "A":**

Slight disabilities—Muscle strength one-half to three quarters normal.

Can run—Classes from 20 to 40 in number.

Cases—Convalescent pneumonia, pleurisy, gas, trench fever, neurasthenia, general debility, and mild diseases of the aorta.

Wounds—Operation or gunshot of any part of the body, with general weakness of that part.

**Group "B":**

Severe disabilities—Muscle strength one-quarter to one-half normal.

Can walk—Groups of not more than 8 under one instructor.

Cases—Patient has lost confidence in the use of the part and requires special exercises and competitions to re-establish his initiative and proper mental attitude.

Wounds—Nerve, bone, or joint in which patient has returning power; adherent scar cases in which tendons and muscles are bound down and there is loss

of function; ankylosed and flail joints; ununited fractures; postural scoliosis; flat-feet; enteroptosis; various types of paralyses, functional and otherwise.

**Group "C":**

Complete disabilities—Muscle strength one-eighth to one-quarter normal.

Can stand—From 1 to 4 patients treated at a time by a specially trained instructor.

Cases—Locomotor ataxia, severe neurasthenia, organic heart disease without failure of compensation.

Wounds—Amputation and wounds of the leg; with or without limb; central nervous system injuries, producing paraplegia or hemiplegia.

### GROUP "A"

Note: Good limb taken as normal.

Thirty minutes daily.

*Chest Group:*

Grade 1:
1. Head bending back, inhaling.
2. Arms upward raising and inhaling.
3. Hips firm, feet sideward place trunk bending backward, inhaling, forward, exhaling.
4. Arms outward flinging, inhaling.
5. Feet together, hips firm, trunk turning.
6. Walking, hips firm, deep breathing.
7. Doubling, arms outward stretching, walking same as No. 6.
8. Lying, supine, inhaling.

Grade 2: Same as above, but adding Swedish co-ordination steps and games.

All exercises must be done slowly, and each individual takes his own time doing any movement when inhalation accompanies same.

*Trunk and Abdominal Group* (hands over scar):

Grade 1. 1. Hips firm, heels raising, knees bending.
2. Hips firm, foot S. Pl., Tr. bending backward and forward.
3. Feet sideward place, arms sideways stretch, trunk bending sideways.
8. Feet sideward place, arms sideways stretch, trunk turning.
5. Hips firm, knees raising, leg stretching forward (balance).
6. Hips firm, trunk rolling.
7. Marching, running, hopping.
8. Arms raising forward, upward, sideways, downward, with deep breathing.

Grade 2. Same as above, with Swedish co-ordination steps and games; and the following lying exercises: Lying on back, neck rest, and leg raising. On hands down, feet placing forward and backward.

*Quadriceps Group:*

Grade 1. 1. Foot placing sideways.
2. Hips firm, heels raising, knees full bending.

3. Feet sideward place, trunk bending backward, forward, and full downward.
4. Hips firm, foot rotation.
5. Hips firm, knee raising, leg stretching forward.
6. Hips firm, feet closed and full open, outward lunging.
7. Hips firm, leg raising forward, sideways, and backward,
8. Knee rolling.
9. Marching, running, hopping (goose step).
10. Games.

Grade 2. Same as above, with leg co-ordination, apparatus work, and games.

*Arm Group:*

Grade 1. 1. Arms bend, arms stretching forward, sideways, up and down.
2. Arms swinging upward.
3. Arms forward bend, arms flinging.
4. Feet sideward place, arms upward stretch, trunk forward bend, arms swinging downward and backward.
5. Clubs, wands, and dumb-bells.
6. Hands down, arms bending and stretching.
7. Hands down, trunk turning with arm flinging.
8. Games.

Grade 2. Same as above, with apparatus work, games, etc.

*Tibial Group:*

Grade 1. 1. Hips firm, heels raised, with heels turned out.
2. Feet closing and opening, heels open and closed, with side traveling.
3. Stationary walk.
4. Hips firm, feet closed, foot rolling.
5. Sitting position, foot circling.
6. Marching, heels raising, running and hopping.

Grade 2: Same as above, with leg co-ordination, games, and apparatus work.

*General Group:*

Grade 1: Leg: Hips firm, heels raising and knees bending quickly.

Neck: Head bending backward.

Arm: Arms swinging upward and downward.

Trunk: Left foot sideways, arms bending, trunk turning with arms, stretching upward.

Balancing: Hips firm, leg raising forward, sideways, and backward.

Lateral: Feet astride, arms sideways stretch, trunk bending sideways quickly.

Abdominal: On the hands down, feet placing forward and backward.

Dorsal: Left foot sideways, arms bending, trunk forward bend, arms stretching upward.

Marching: Quick march, slow march, marching on the toes.

Running: Double march, leap-frog, knees up.
Breathing: Arms raising upward, sideways and downward, with deep breathing.
Games.

Grade 2: Leg: Hips firm, foot placing sideways, with heels raising,
Hips firm, heels raise, knees full bend.
Neck: Head bending backward and sideways, head turning.
Arm: One arm upward, one arm downward stretch, trunk bending sideways.
Balancing: Arm raising forward, sideways, up and down.
Lateral: On the left hand, down leg raising.
Abdominal: On the back down, leg raising.
Dorsal: Feet sideward place, arms upward stretch, trunk forward bend. Arms swinging downward and backward.
Marching: Quick march, knee raising, hopping on left and right foot, slow march.
Running: Double march.
Breathing: Arms raising forward and upward, lowering sideways and downward with deep breathing.
Jumping: Box horse, on the knee and off, on the feet and off, between the hands, right and left vault, splits over, clear jump.
Games.

## GROUP "B"

Squads of from 4 to 8 patients working with the ordinary gymnasium equipment under a trained instructor. Thirty minutes daily.

*Shoulder Group:*

Grade 1: Pulley weight exercises, weights from 0 to 10 pounds.

Grade 2: Pulley weight exercises, weights from 6 to 16 pounds.

Clubs, Grade 1. (One arm acting.)

Wands, competitive. (French Army.)

Wands, Grade 1.

Punching-bag. Rowing machine.

Badminton, tether ball.

Grade 3: Pulley weight exercises, weights from 10 to 16 pounds.

Clubs, Grade 2. (Two arms acting.)

Dumb-bells. Wall bars.

Heaving exercises.

Badminton, squash, tether ball, volley ball, throwing.

*Elbow Group:*

Grade 1: Pulley weights, weights from 0 to 10 pounds.

Grade 2: Pulley weights, weights from 6 to 16 pounds.

Grades 1 and 2 clubs.

Rowing machine. Punching-bag.

Twisted wands and wand rotation.

Badminton, tether ball.

Grade 3: Pulley weights, weights from 10 to 16 pounds.
Grade 2 clubs. (Both arms acting.)
Scolioses bar exercises. Wall bars.
Heaving exercises.
Badminton, squash, tether ball, volley ball, giant hole throwing.

*Hand Group:*

Grade 1: Pulley weights, weights from 0 to 10 pounds, with glove.
Clubs, Grades 1 and 2, with glove.
Punching-bag with glove.
Games with racquet, with glove.

Grade 2: Pulley weights, weights from 0 to 10 pounds.
Clubs, Grades 1 and 2.
Wands, competitive. (French Army.)
Scoliosis bar gripping.
Games with racquet, volley ball.

Grade 3: Pulley weights, weights from 6 to 16 pounds.
Clubs, Grades 1 and 2.
Games with racquet, volley ball, giant hole.
Heaving exercises.

*Ulnar Group:*

Grade 1: Pulley weights, weights from 0 to 10 pounds.
Clubs, Grade 1 with glove. (One arm acting.)
Twisted wands with glove.
Scoliosis bar with glove.

Grade 2: Pulley weights, weights from 0 to 10 pounds.
Clubs, Grades 1 and 2.

Twisted wands.
Scoliosis bar exercises.
Volley ball, polota, racquet games.

Grade 3: Pulley weights, weights from 0 to 10 pounds.
Clubs, Grades 1 and 2.
Twisted wands.
Scoliosis bar exercises.
Heaving exercises.
Volley ball, polota, racquet games.

*Medial Group:*

Grade 1: Pulley weights, weights from 0 to 10 pounds, with glove.
Clubs, Grades 1 and 2, with glove.
Twisted wands, with glove.
Punching-bag exercises, with glove.
Scoliosis bar exercises, with glove.
Racquet games, with glove.

Grade 2: Pulley weights, weights from 0 to 10 pounds.
Clubs, Grades 1 and 2.
Twisted wands.
Scoliosis bar exercises.
Racquet games, giant hole.
Wands, competitive. (French Army.)

Grade 3: Pulley weights, weights from 6 to 16 pounds.
Clubs, Grades 1 and 2.
Racquet games, giant hole.
Heaving exercises.

*Musculospiral Group:*

Grade 1: Pulley weights (H. H.[1]), weights from 0 to 8 pounds, with glove.

Grade 2: Pulley weights (H. H.), weights from 4 to 18 pounds.
Punching-bag.
Scoliosis bar exercises.
Volley ball throwing.

Grade 3: Pulley weights (H. H.), weights from 10 to 16 pounds.
Volley ball, Badminton, squash, giant hole, throwing.
Shot put.
Parallel bar exercises.

*Sciatic Group* (Ext. Popliteal):

Grade 1: Dorsiflexion, supination, eversion without body weight.

Grade 2: Dorsiflexion, supination, eversion with body weight.
Leg co-ordination steps, Grade 1 (walking).
Wall bars.
Badminton.
Volley ball.

*Hip Group:*

Grade 1: Extension, flexion, abduction, adduction, and rotation without full body weight.

[1] H. H. denotes the apparatus used at Hart House, Toronto, Canada.

Grade 2: Extension, flexion, abduction, adduction, and rotation with the full body weight.
Leg co-ordination steps, Grade 1 (walking).
Rowing machine.
Grade 3: Leg co-ordination steps, Grade 2 (hopping).
Rowing machine.
Volley ball, Badminton.

*Knee Group:*

Grade 1: Flexion, extension, and rotation without body weight.
Grade 2: Flexion, extension, and rotation with body weight.
Leg co-ordination steps, Grade 1 (walking).
Grade 3: Leg co-ordination steps, Grade 2 (hopping).
Rowing machine.
Volley ball, Badminton.

*Foot Group:*

Grade 1: Sitting: Supination with plantar flexion, foot inverted.
Pronation, dorsiflexion, foot inverted.
Foot rolling.
Heels raising, foot inverted.
Grade 2: Standing: Foot forward placing, supination and inversion.
Feet inverted, heels raising. Foot rolling.
Dorsiflexion, supination.
Tip-toeing, foot crossing on mats and springs.
Leg co-ordination steps, Grade 1 (walking).

Grade 3: Walking: Same as Grade 2 with leg co-ordination, Grade 2 (hopping).
Volley ball, Badminton.

*Scoliosis Group:*

Grade 1: Keynote position, leg swinging forward, sideways, and backward.
Trunk bending sideways.
Hips firm, convex side.
Neck firm, concave side.
Arms swinging upward to keynote position.
Arms swinging downward with chest lifting.

Grade 2: Scoliosis bar exercises.
Hanging keynote and Lovett positions.
Wall bars.
Plinth.

**"B" EXERCISES**

1. Head bending backward.
2. Hips firm, heels raised, knees bend.
3. Arms bend, arms stretching forward, sideways, and upward.
4. Hips firm, feet closed, trunk turning with deep breathing.
5. Hips firm, feet sideways, place by numbers.
6. Hips firm, foot sideways, trunk bending backward with deep breathing.
7. Feet closed, heels raise.
8. Hips firm, foot sideways, trunk rolling once in each direction.

9. Palms turning outward with deep breathing.
10. Hips firm, heels raise, knee bend.

### "C" EXERCISES

1. Head backward bend.
2. Heels raise, knees bend.
3. Arms bend, arms stretching forward, sideways, upward.
4. Hips firm, feet closed, trunk turning with deep breathing.
5. Hips firm, leg raising forward, sideways, backward.
6. Hips firm, foot sideways, trunk bending forward, trunk bending backward with deep breathing.
7. Hips firm, foot sideways, place by numbers.
8. Arms bend, foot sideways, trunk rolling once in each direction.
9. Arms circling with deep breathing.
10. Hips firm, heels raise, knees bend.

### "B," "C" EXERCISES

### "B," "BC" EXERCISES THIRTY MINUTES

1. Head bending backward.
2. Hips firm, foot placing sideways by numbers.
3. Arms bend, one arm upward and one arm downward stretch.
4. Hips firm, foot sideways, trunk turning, deep breathing.
5. Hips firm, feet full open, heels raise and full knee bend.

6. Arms bend, feet sideways, trunk bending backward with deep breathing.
7. Hips firm, knee raise, leg stretching forward.
8. Feet closed, one arm up and one arm down stretch, trunk bending sideways.
9. Hips firm, leg raising sideways.
10. March, quick march, on toes march.
11. Arms circling with deep breathing.
12. Games, medicine balls, etc.
13. Arms raising sideways with deep breathing.
14. Heels raising and knee bending.

### "C30" EXERCISE

1. Head backward bend.
2. Hips firm, heels raise, knees bend.
3. Arms sideways raise, arms forward bend, arms flinging.
4. Arms bend, foot sideways, trunk turning quickly.
5. Arms bend, feet full open, heels raise, full knee.
6. Feet sideward place, arms sideways stretch, trunk bending backward with hands turning and deep breathing.
7. Hips firm, leg raising sideways.
8. Hips firm, left foot sideways, trunk bending forward and full downward.
9. Places change.
10. One arm upward and one arm downward, trunk bending sideways.

11. Feet sideward place, arms upward stretch, arms swinging downward and backward.
12. Quick march, on the toes march, double march.
13. Medicine ball, games, etc.
14. Arms raising sideways and upward, lowering sideways and downward with deep breathing.
15. Hips firm, heels raise, knees bend.

### "D30" EXERCISE

1. Head backward bend.
2. Arms bend, feet full open, heels raise and knee bend, arms stretching sideways.
3. Head turning with deep breathing.
4. Arms swinging upward.
5. Arms bend, foot sideways, trunk turning quickly with arms stretching upward.
6. Hips firm, foot placing sideways with heels raising.
7. Feet sideward place, arms sideways stretch, trunk turning backward with hands turning and deep breathing.
8. Hips firm, leg raising forward, sideways, and backward.
9. Left foot sideways, arms bend, trunk bending forward and full downward.
10. Left foot sideways, arms bend, trunk bending sideways with deep breathing.
11. Feet sideways place, arms upward stretch, trunk bending forward, arms swinging to the horizontal.

12. Hips firm, with knee raising, quick march on the toes, double march.
13. Medicine ball, games, etc.
14. Hips firm, heels raise, knee bend.

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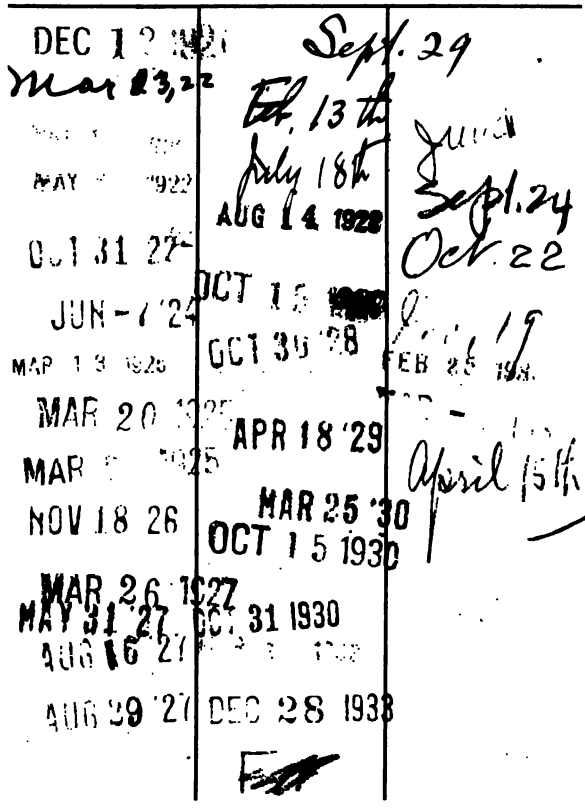

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